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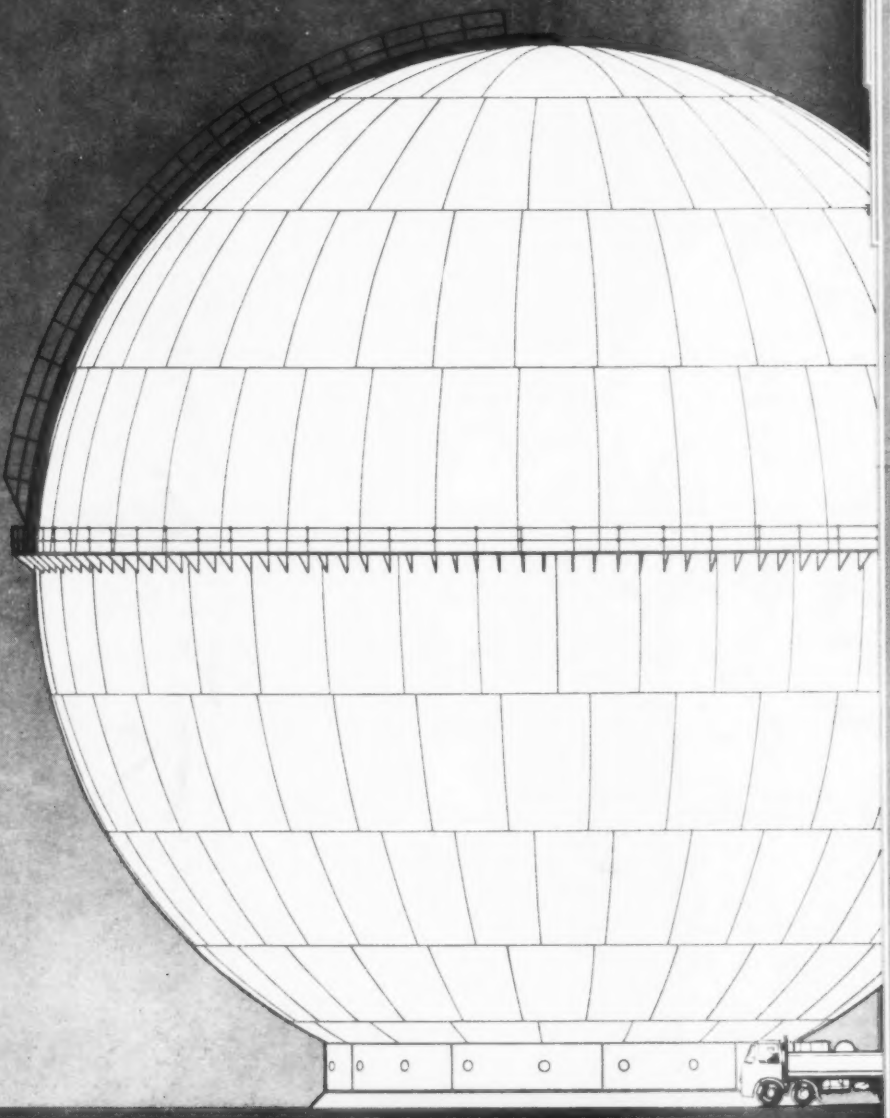
THE ARCHITECTS' JOURNAL

BUILDING FOR ATOMIC POWER PLANT



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B.Th.U'S PER HOUR FOR HOT WATER SUPPLY		FUEL CAPACITY (CUB. FT.)	HEATING SURFACE (SQ. FT.)	GRATE AREA (SQ. FT.)	GALLONS PER HOUR (FROM 50°F-130°F)	
NORMAL RATING	SLOW-BURNING RATING				NORMAL RATING	SLOW-BURNING RATING
20,000	12,000	0.70	1.82	0.45	25	15

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		ASHPIT DOOR CLOSED	ASHPIT DOOR OPEN	FLOW	RETURN		
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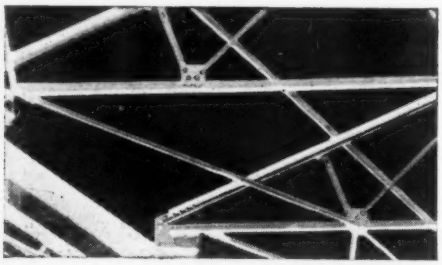

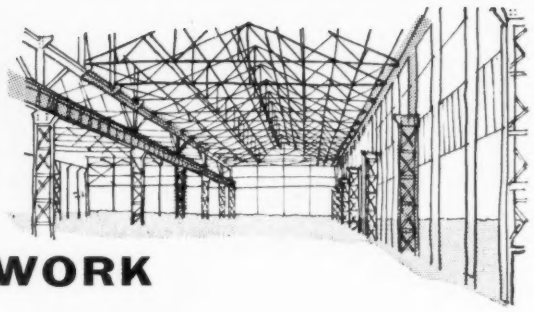

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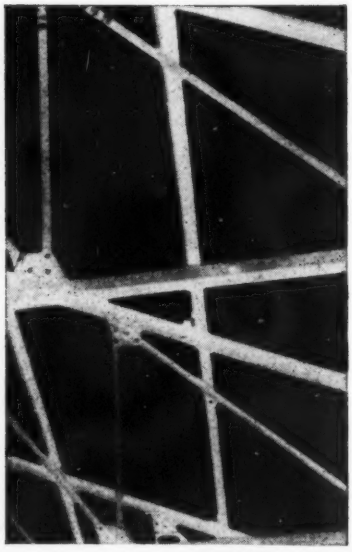

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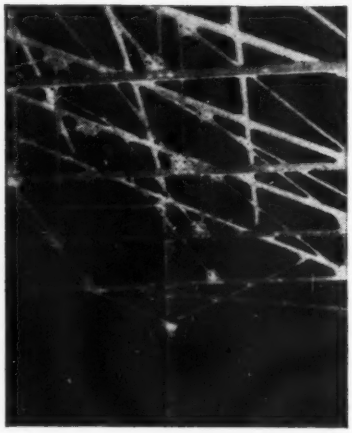

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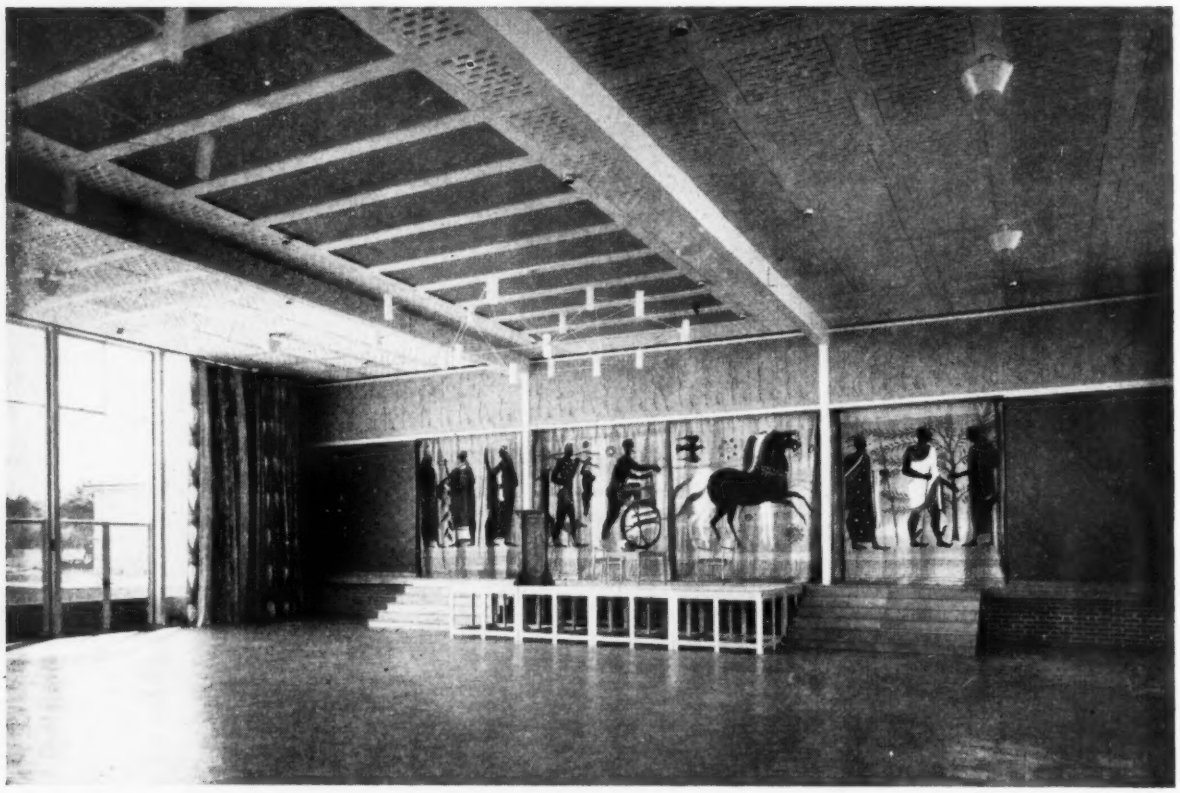

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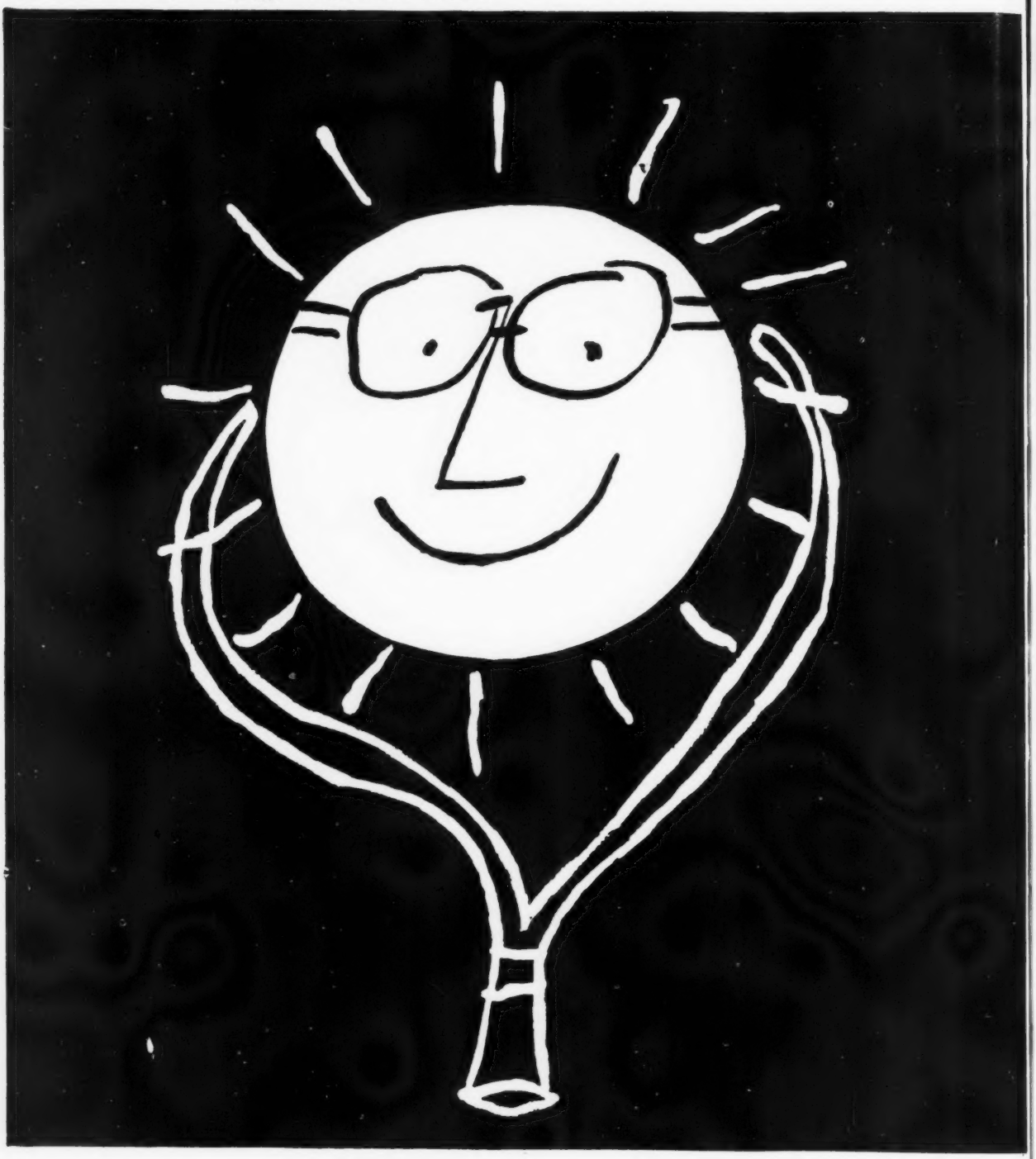

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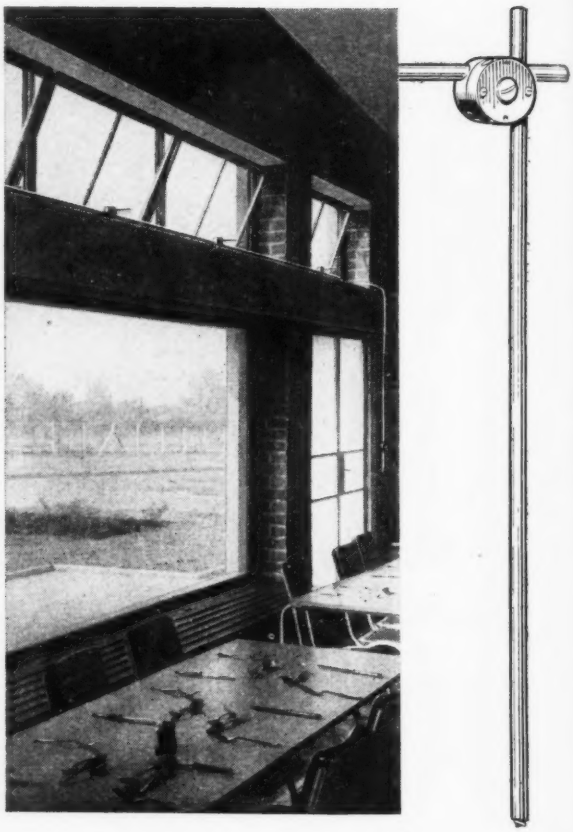

Illustration shows part of the canteen at the Administration and Design Office of W. J. Fraser & Co. Ltd., at Harold Hill, where Teleflex Remote Controls were used for window operation.

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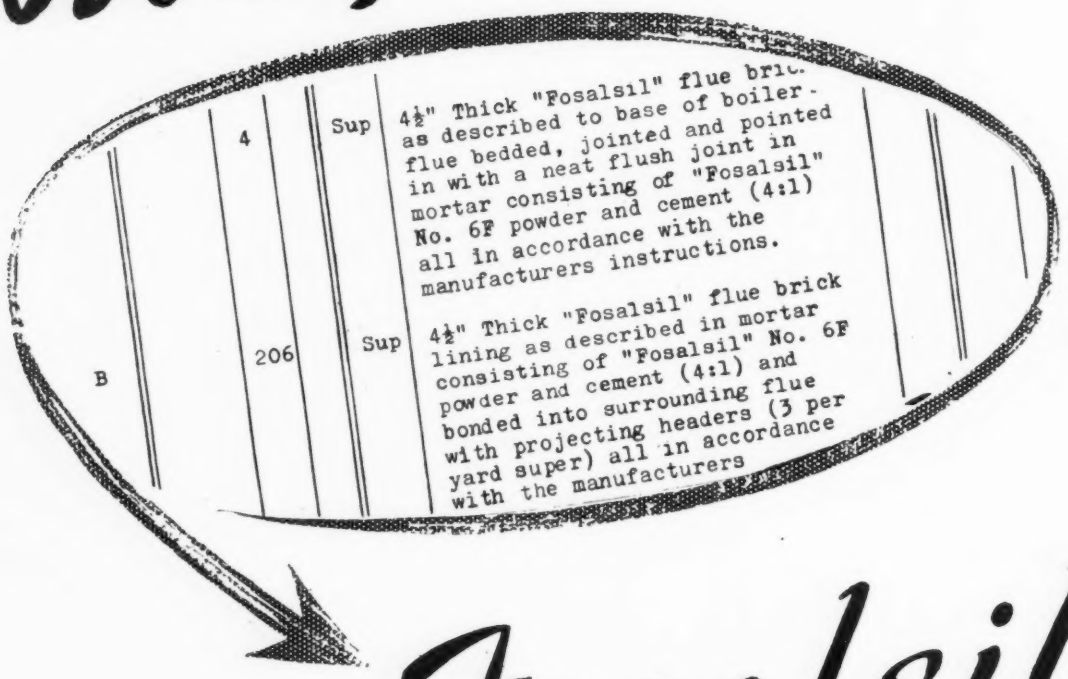

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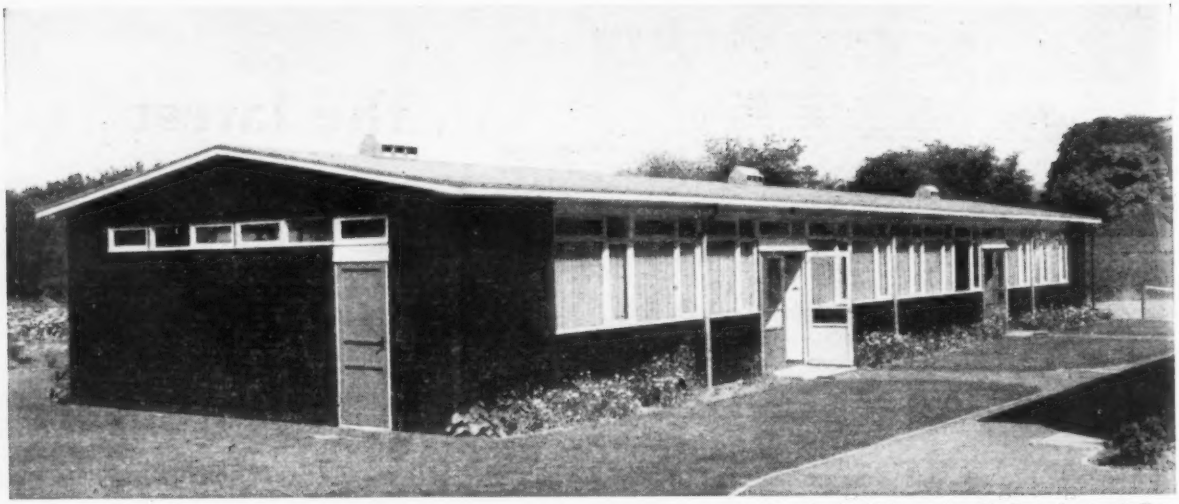

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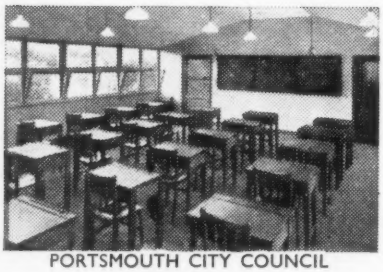

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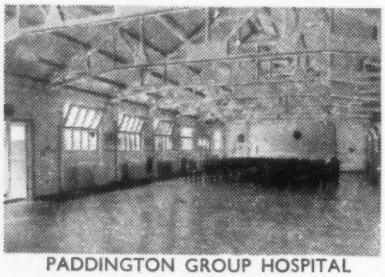

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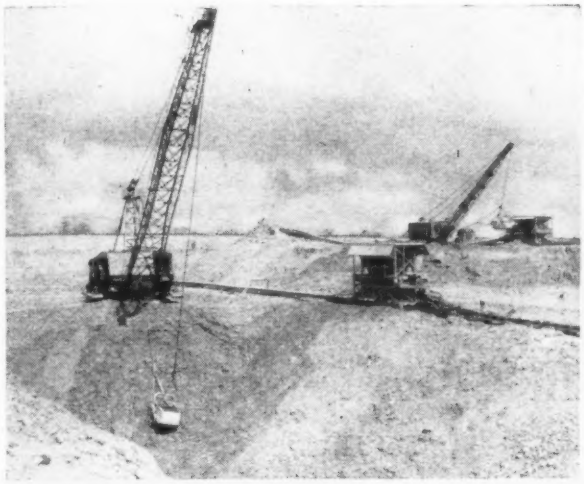

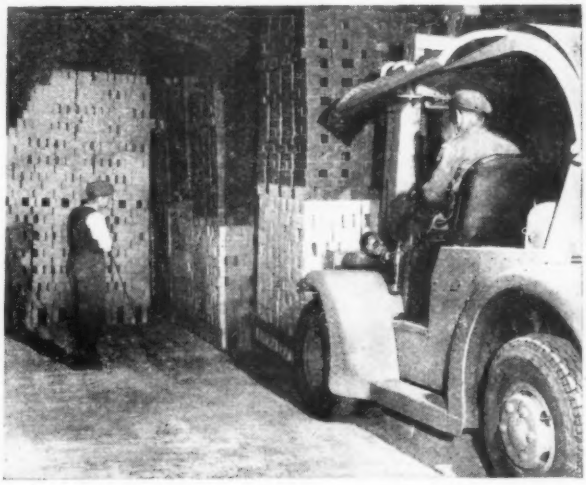

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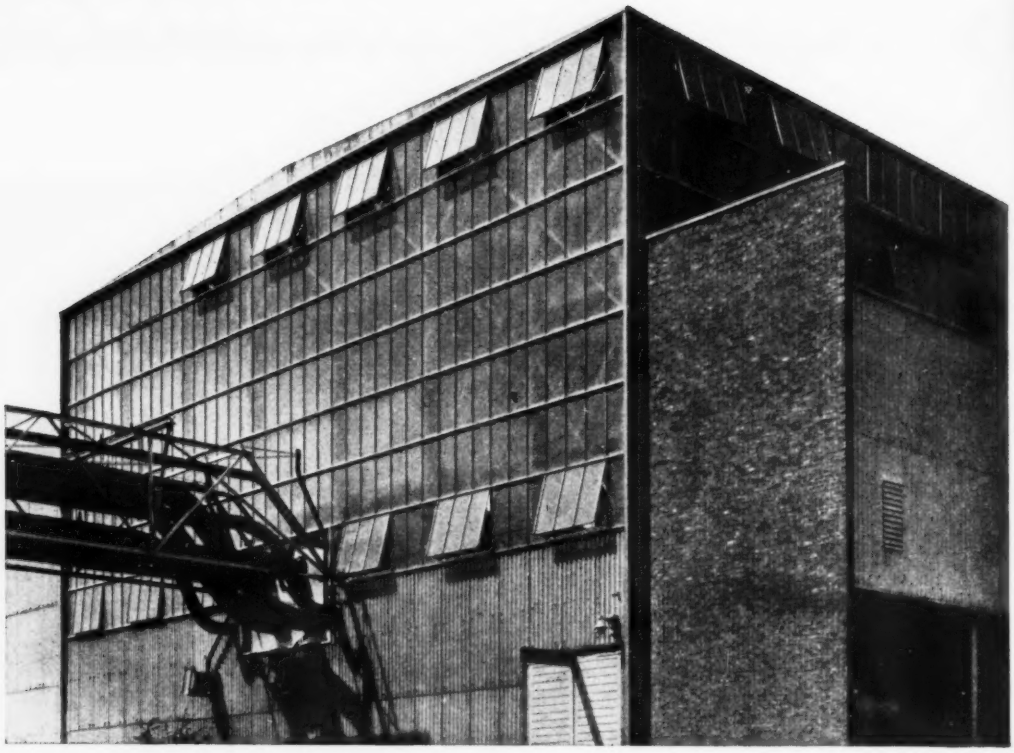

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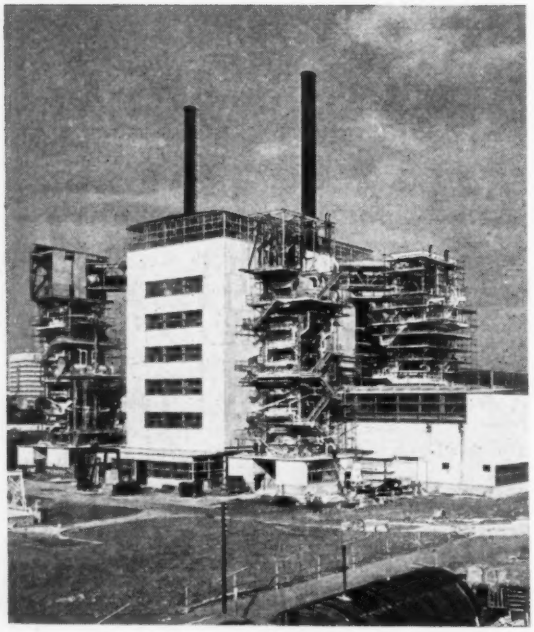

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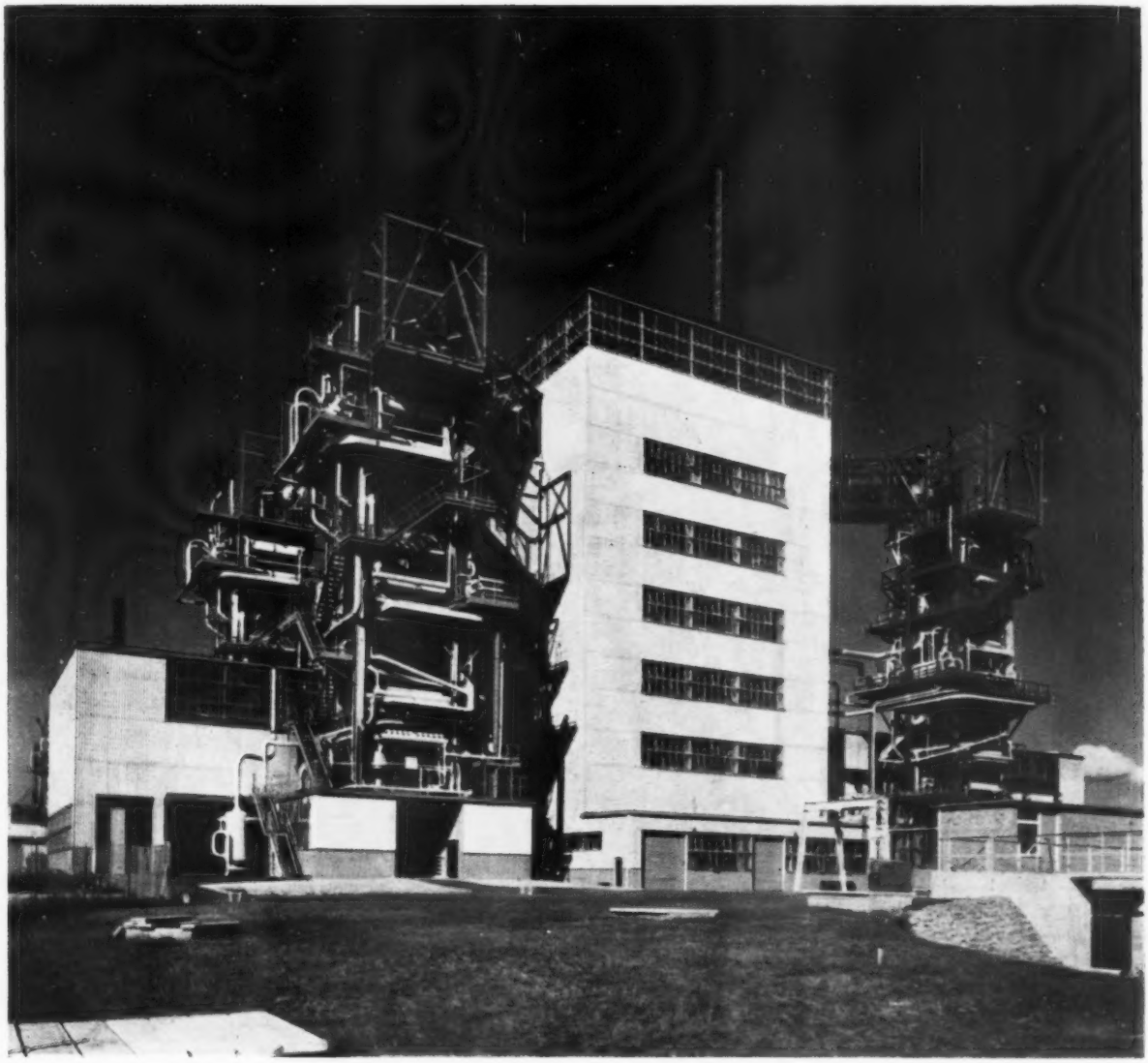

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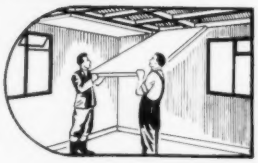

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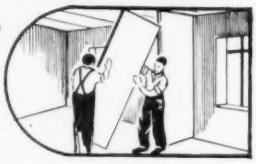

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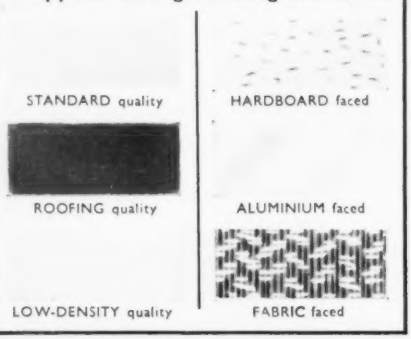

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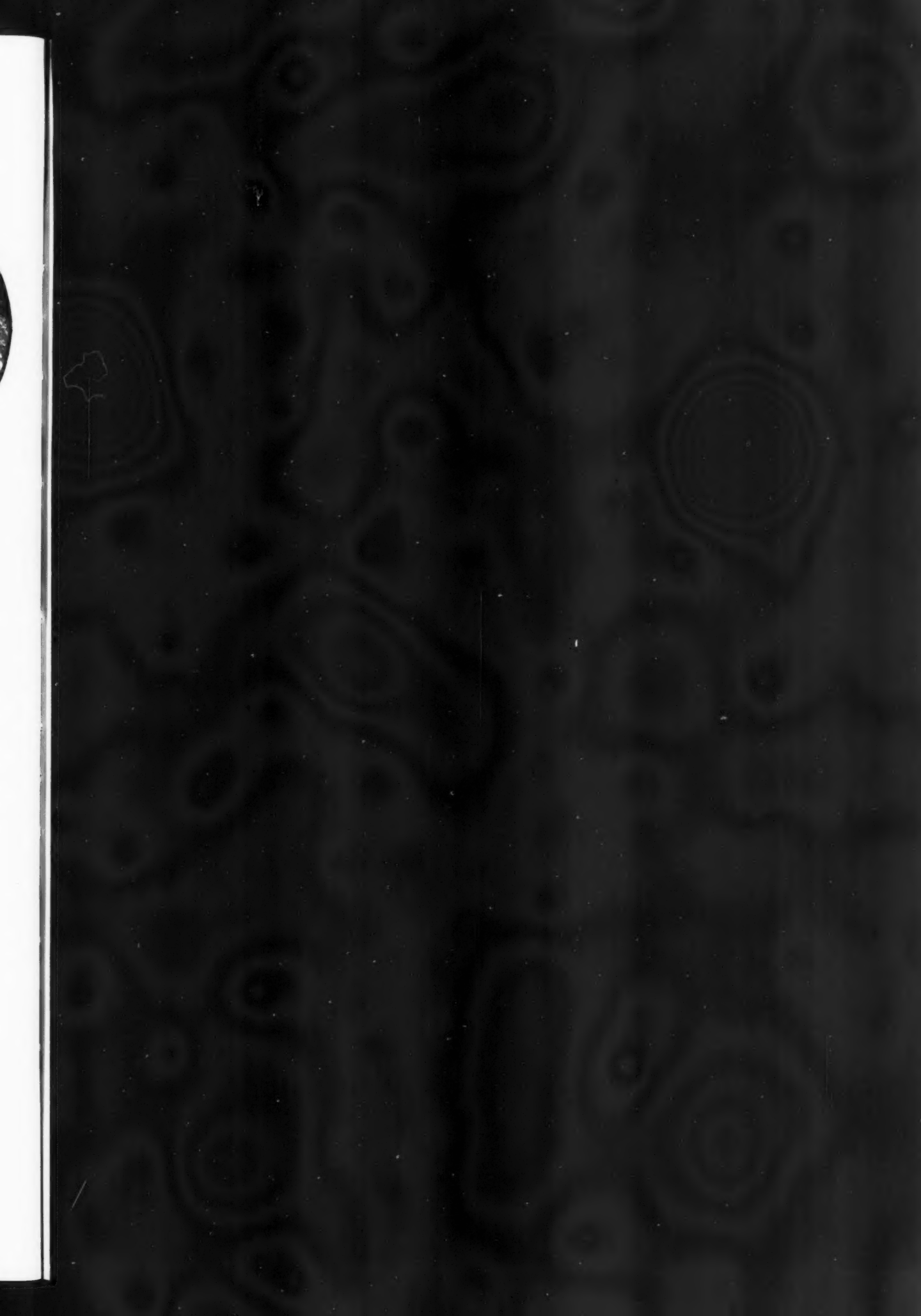

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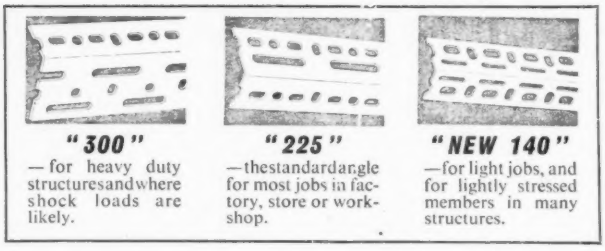

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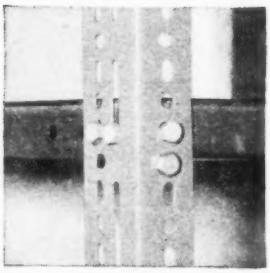
— for light jobs, and for lightly stressed members in many structures.

•NEW SELF-SUPPORTING, Rigid Shelves No bearers—a big saving

Dexion storage installations can be "tailored to fit" both the goods and the space — often, space otherwise wasted. The new Dexion shelves bolt direct to uprights; locking design gives built-in rigidity. Without bracing or bearers, the job is neater, quicker, cheaper. A unique feature: bolted support bars can increase load capacity of shelves wherever needed.

Five sizes:
Rust-protected and stove-enamelled, Dexion steel shelves give a fine finished job at low cost. Sizes: 36" x 12", 18", 24", 30" and 36". (Also original Dexion panels, for use with bearers, 36" x 6".)



•THE DEXION MAN has a trained eye for cost-saving

The Dexion representative is trained to find an efficient solution to *your* storage or equipment problem. His practical experience can help you save money, space, labour, with Dexion structures exactly fitting your needs, in factory, warehouse or office. As many customers have found, you may gain a lot by calling him in.

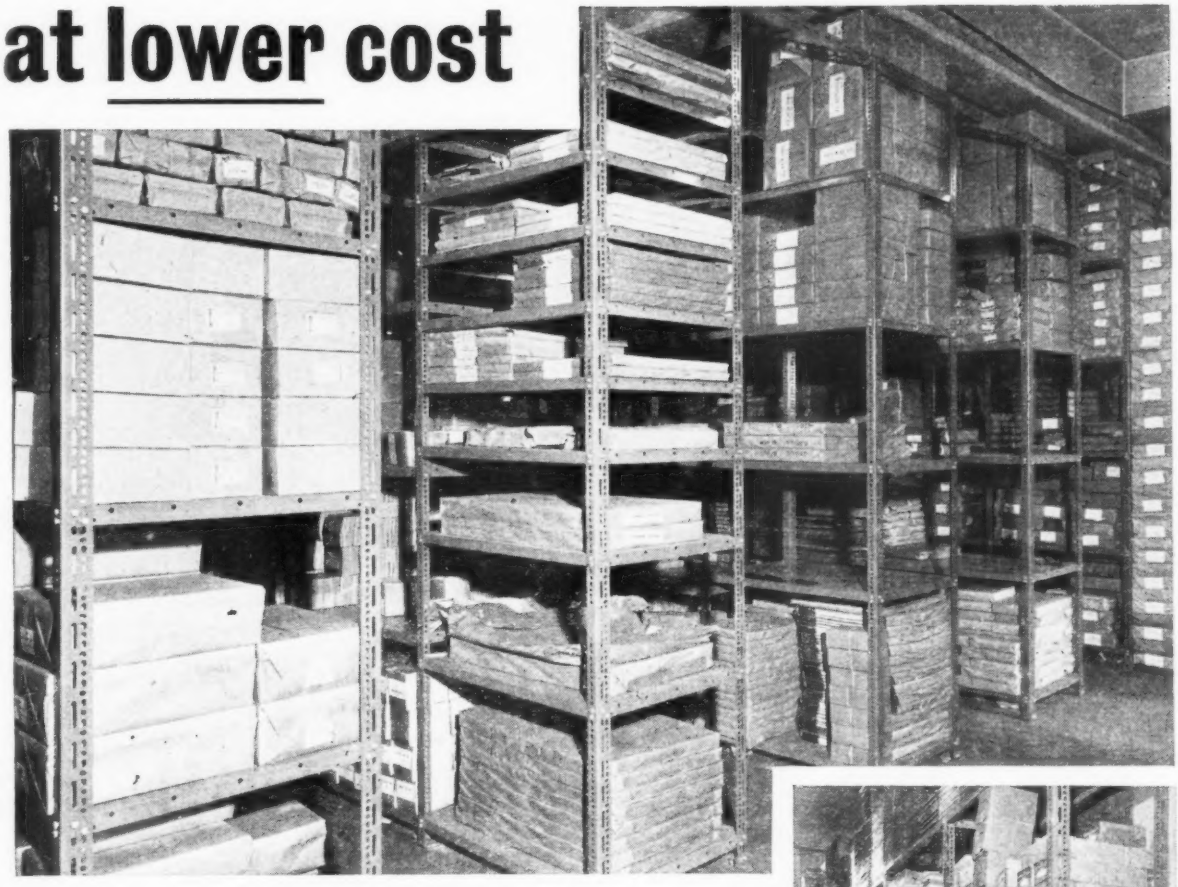
DEXION DESIGN SERVICE

Dexion is far easier to use than wood or angle iron — so most jobs present no difficulty. But where the installation is fairly big, or there are tricky features, careful design can mean substantial savings. The Dexion Design Service takes the worry off your hands. It is free to customers: don't hesitate to use it — preferably at an *early* stage of planning.

DEXION CONSTRUCTION SERVICE

If you have not the labour needed to erect the bigger structures, you can have the whole job done by a skilled Dexion team — with speed and efficiency that keep the cost low.

at lower cost



What's so special about DEXION?

Today there are, of course, other slotted angles. But Dexion, which started an entire industry, remains far and away in the lead — and not only because of its sound engineering design.

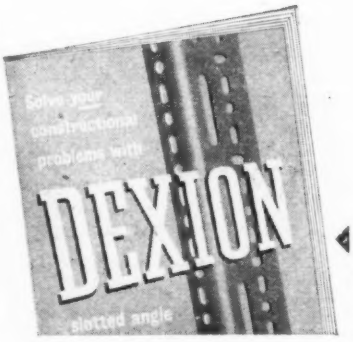
Dexion leads because this organization *is concerned solely with slotted angle* — giving you the best material to solve your problems at the lowest cost, with free technical service to help you, based on unrivalled research and experience.

The demand is now world-wide; Dexion is manufactured in six countries; over 150 million feet are already in use, and *80 per cent of sales are repeat orders.* This success is the surest proof that the Dexion system has, indeed, something special to offer every user.

Complete reorganization of busy wholesale department at H. J. Ryman Ltd., Stationers and Printers. Dexion 225 slotted angle and new shelves make the most of cubic space and facilitate handling of materials. Installation designed and erected by Dexion Ltd.

AT ANY TIME — BUT BEST AT THE PLANNING STAGE —

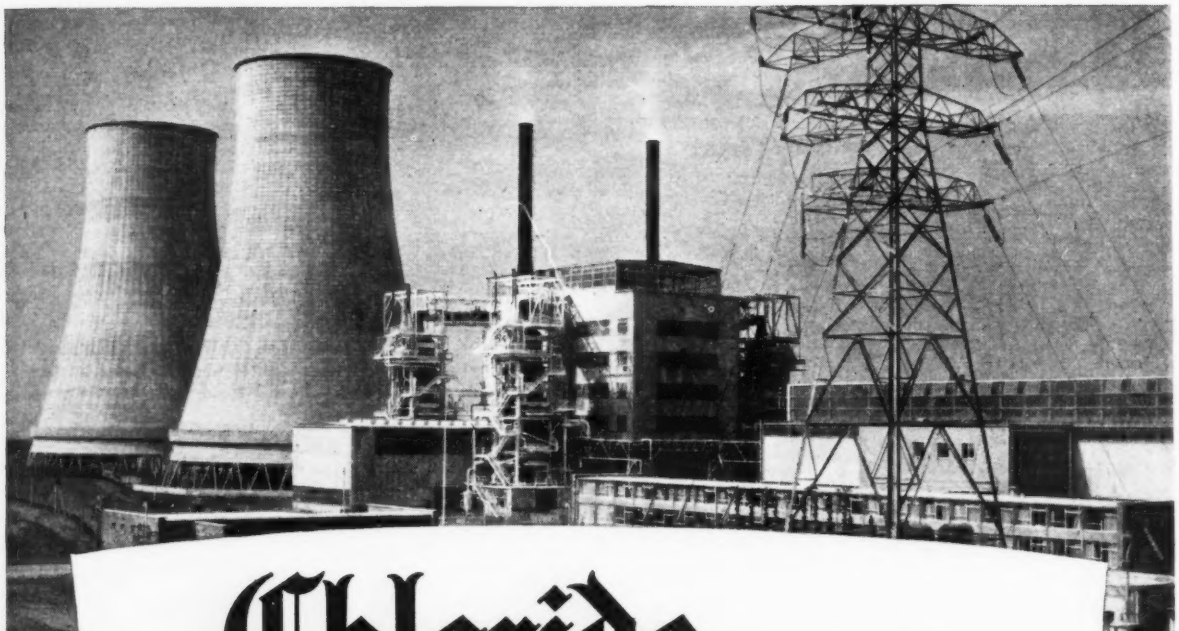
GET IN TOUCH WITH



DEXION

REGD.

THIS BOOKLET IS FULL OF IDEAS. To judge Dexion's usefulness to *you*, send for booklet B.G. 143. Illustrations show how up-to-date firms use Dexion to solve dozens of problems. Full description of the Dexion system, with prices. Just write "B.G. 143." on your business letterhead, and post to Dexion Ltd., 65 Maygrove Road, London, N.W.6. Or ring MAlda Vale 6031-9.



Chloride guards the Reactors at CALDER HALL

To provide emergency power for the auxiliary services of the two Reactors at Calder 'A' Power Station, two large Chloride batteries have been installed. The two batteries are identical and each consists of 120 cells type OFW13 which are assembled in substantial lead-lined wooden boxes. Each cell has a capacity of 1,950 Ah at the 10-hour rate.

Each battery operates on a floating trickle charge routine and is connected in parallel with a 400 kW mercury arc rectifier which supplies the D.C. power for the essential services for each Reactor. These services comprise pumps, fans, instrumentation and emergency lighting. In the event of a failure of the D.C. power from the rectifier for any reason, the Chloride battery automatically continues to supply the 1,200 ampere load: and is capable of doing so for a period of 30 minutes.

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Makers of Exide Batteries

S.88

growth

Ten...fifteen...twenty feet high, the termite or 'white ant' builds its fantastic hill, ever building upwards to accommodate the growing colony. Inside this gigantic structure is a most complicated maze of passages and chambers —complicated because the white ant, although industrious, is blind and cannot see the advantages of efficient planning.

Unlike the white ant we can seldom extend our industrial buildings by outward expansion to accommodate the growing organisations which they contain. This vital problem in industry can, however, be overcome by more efficient allocation of working space by the use of *movable* internal walls—walls which can be easily and quickly erected, dismantled and re-erected as today's and any future space-needs dictate.

The Rowe Organisation specialises in the manufacture of movable walls of various types to suit any location in industrial, commercial or public buildings. These walls, constructed of standard partition units, allow for full provision of glazing, doors, wiring, and a comprehensive range of fittings. They are being widely used by leading Architects in this country and overseas for both new and existing buildings.

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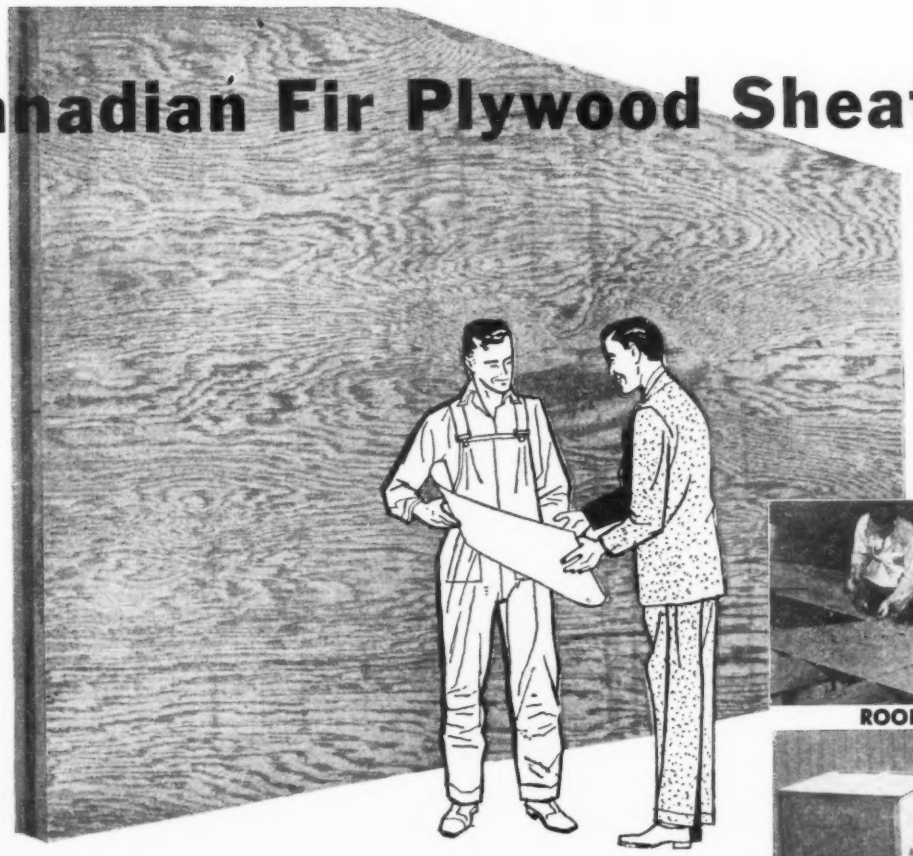
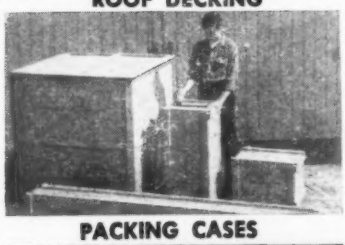


ROOF DECKING



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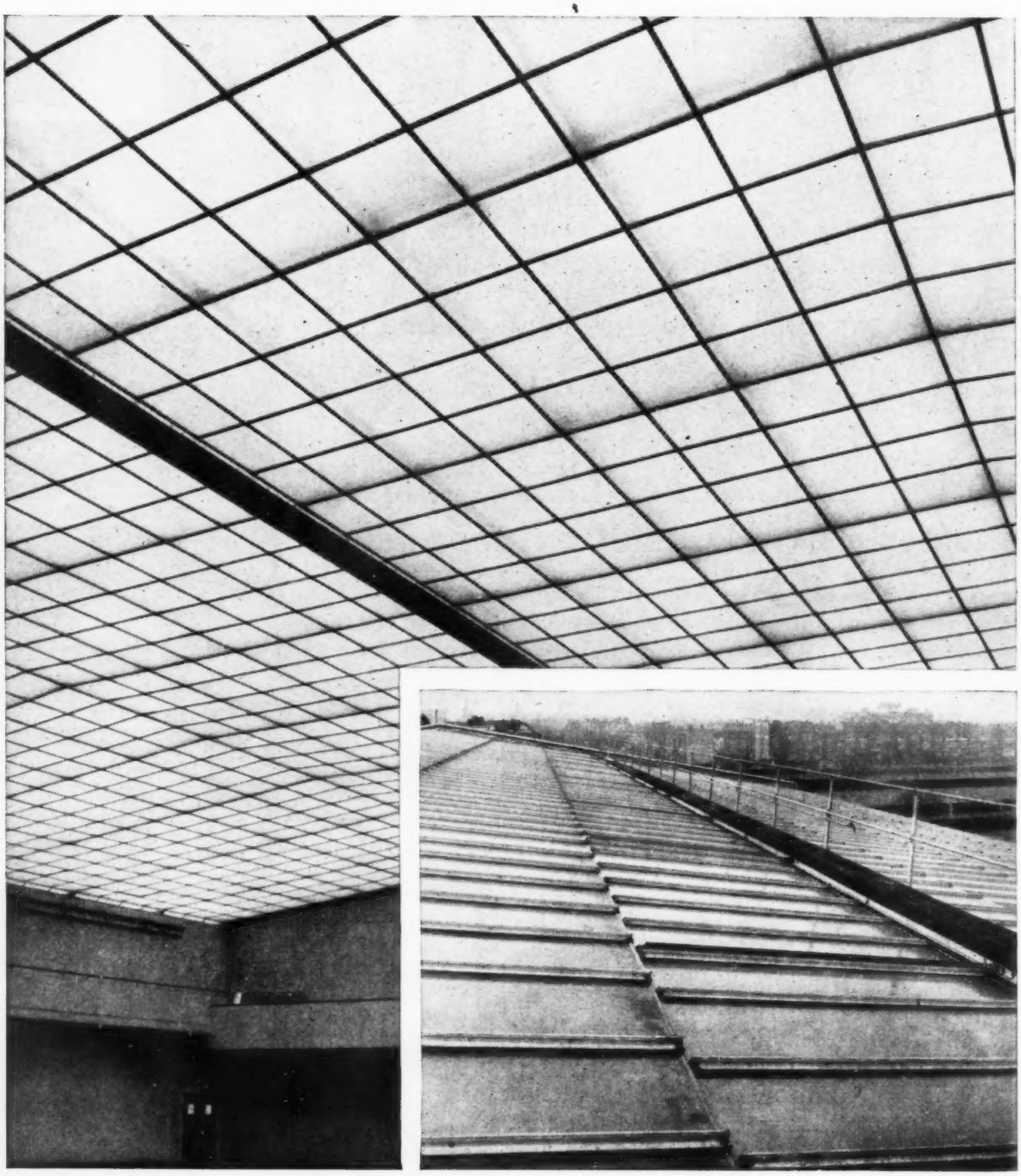
QUEEN'S CLUB,

Architect: *T. Mortimer Burrows & Partners, London W.C.1.*



SPECIFICATIONS

WEST KENSINGTON

Contractors: *Kirk & Kirk Ltd., London S.W.15.*

The Queen's Club, Kensington, is a striking example of the effectiveness and efficiency of Patent Roof Glazing. A single span roof (120' 0" span) glazed eight panes deep at each side of the ridge, covers an area of nearly 17,000 ft. super. This includes aluminium alloy bars with ¼" Georgian wired glass, plus opening lights and accessibility walkways.

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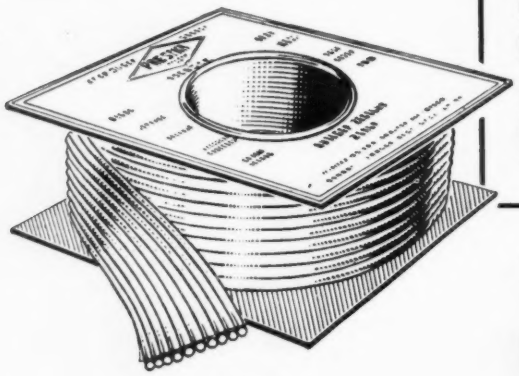

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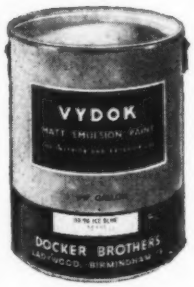

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FILLEX

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★ has exceptional adhesive properties and can even be used on glazed tiles to produce a smooth surface for painting.
★ has excellent keeping qualities (but should be protected from frost).
★ is supplied in 4 lb. and 16 lb. tins.
PRICE: 4 lb. tins at 1s. 6d. per lb. 16 lb. tins at 1s. 3d. per lb.

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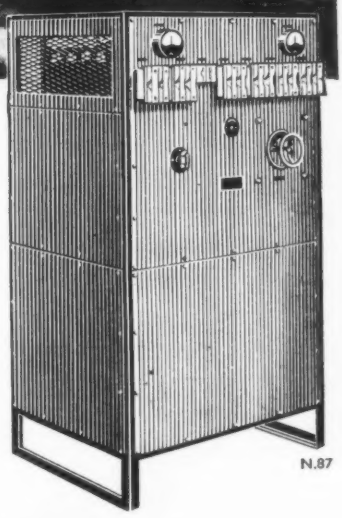

N.87

YOU CAN BE CERTAIN TOO that Nife-Neverfayle Emergency Lighting Equipment will never let you down. *Whenever* needed, these reliable units will instantly, automatically spring into action. That is the special advantage of the Nife Steel Alkaline Battery—it never deteriorates, even after long periods of inactivity.

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THE EMERGENCY LIGHTING EQUIPMENT WITH THE **STEEL** ALKALINE BATTERY

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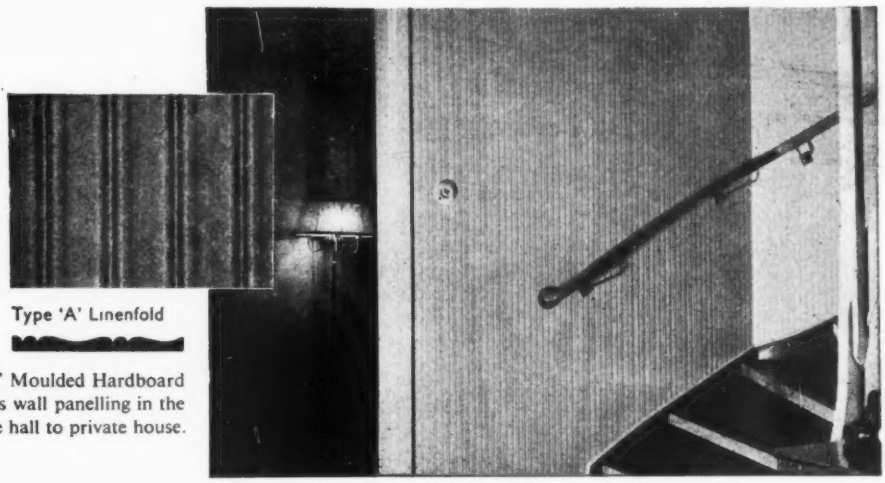

Type 'A' Linenfold

Type 'A' Moulded Hardboard used as wall panelling in the entrance hall to private house.

material benefits

The many "material benefits" of LW Swedish Hardboard have been greatly increased by the introduction of Moulded Board. Supplied in standard 4′ x 9′ sheets, $\frac{1}{8}$″ thick, the six distinctive designs and ease of fitting give LW Board a versatility ideally suited for home modernisation, hotel bars, shops, foyers, exhibitions and partitions. Both the normal and oil tempered quality are equally effective either in their rich natural colours, or painted. To cover unsightly walls, for the speedy erection of large areas or as the basis of attractive design, LW Moulded Hardboards are the obvious answer. Send to-day for full details.

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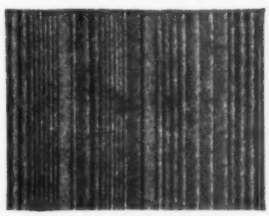
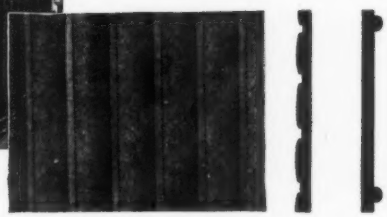
Type 'A' Hardboard used in the Lounge Bar of the Llanrumney Hall Hotel, Cardiff. Owners: Wm. Hancock & Co. Ltd. Architect: G. L. H. Rogers, L.R.I.B.A.

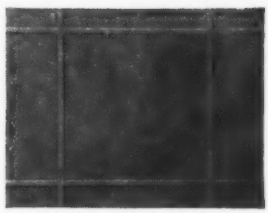


Type 'C' Striated

Type 'D' Slatted



Type 'E' Close Slatted



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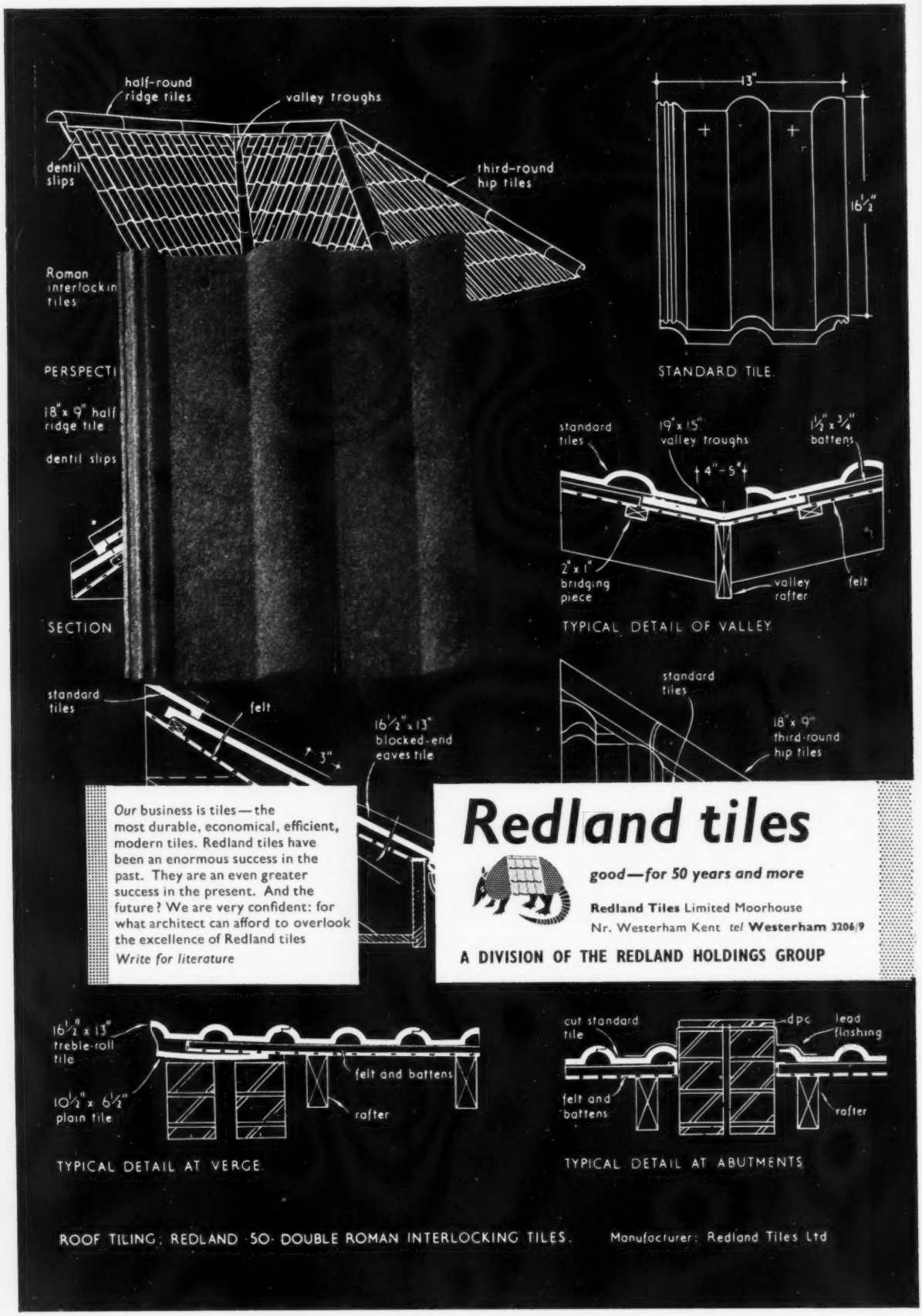

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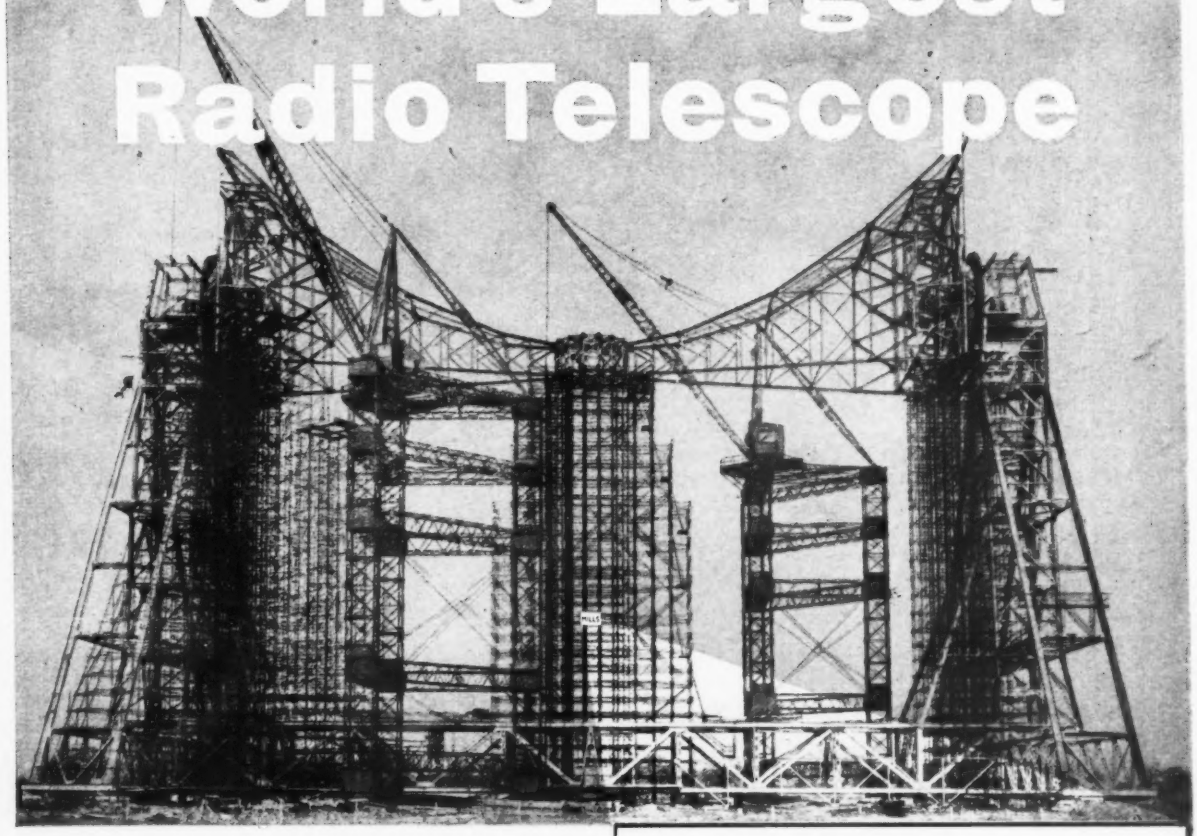

ALTAZIMUTH PARABOLOID RADIO REFLECTOR AT THE JODRELL BANK SITE, BUILT FOR MANCHESTER UNIVERSITY AND THE DEPARTMENT OF SCIENTIFIC & INDUSTRIAL RESEARCH. CONSULTING ENGINEERS: HUSBAND & CO., SHEFFIELD. STEELWORK CONTRACTORS: UNITED STEEL STRUCTURAL CO. LTD.

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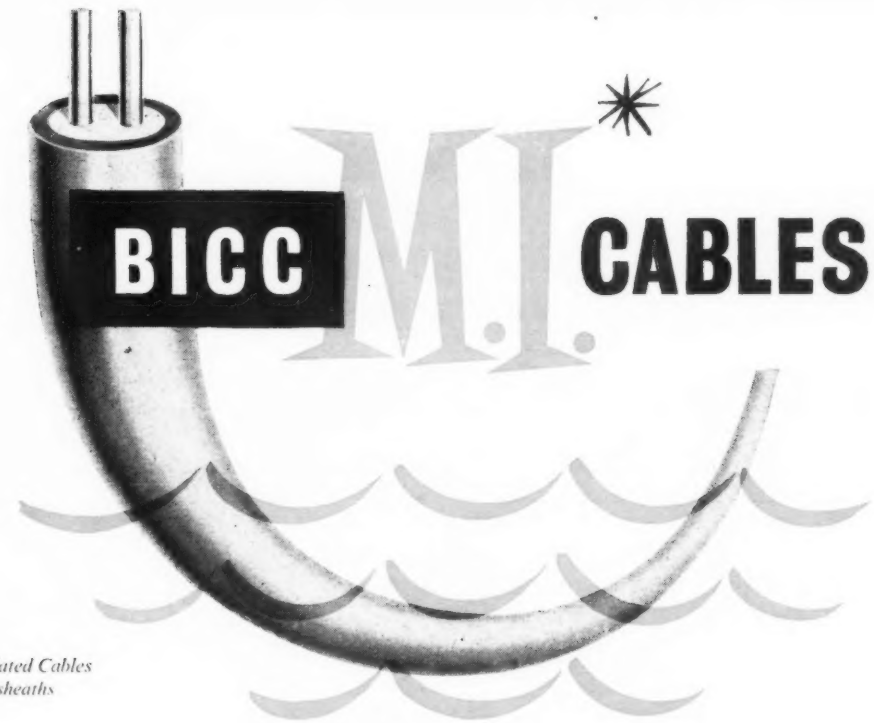

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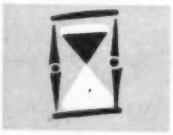

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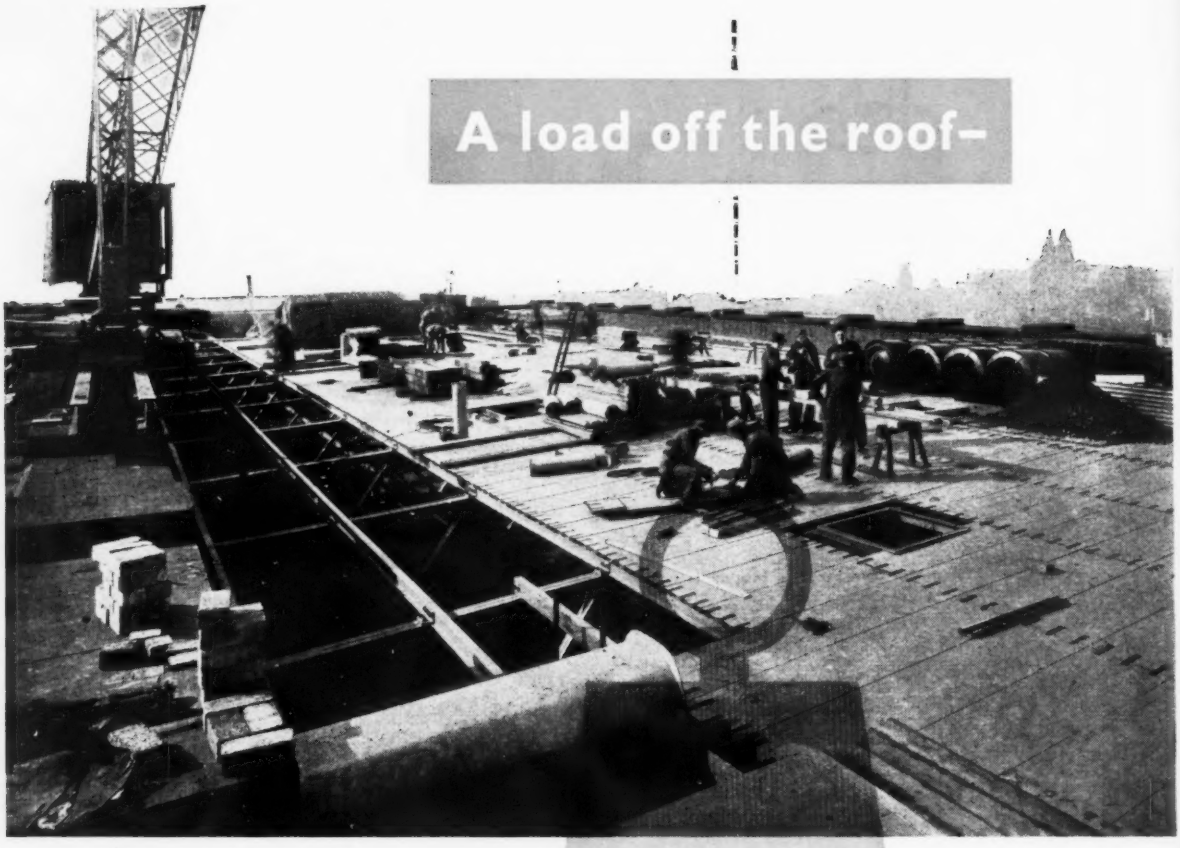

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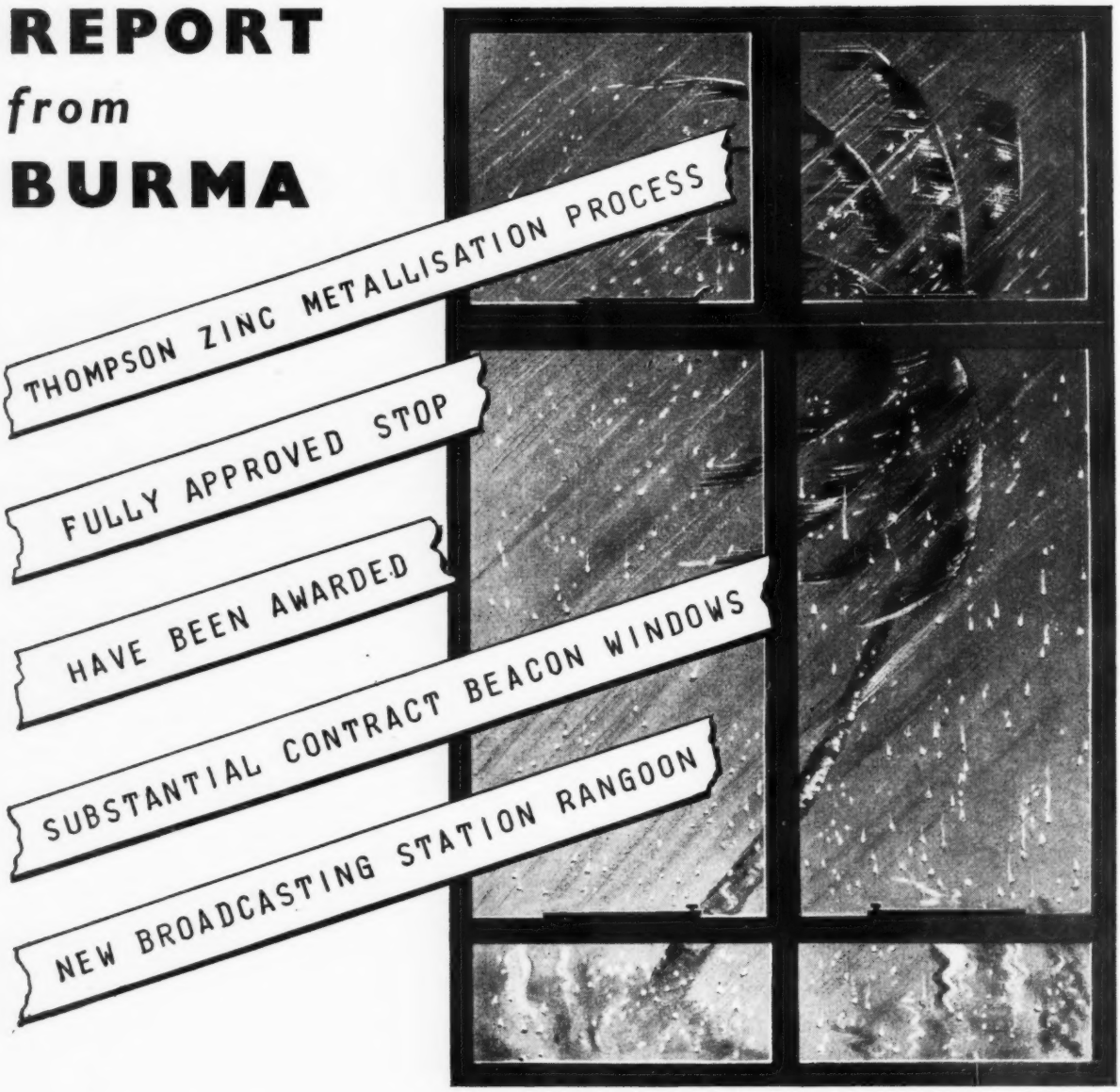

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Yet these conditions, tough as they are, present no problems to architects and builders choosing Beacon Windows. For experience has proved to them that the Thompson Zinc Metallisation Process gives complete life-long protection against the ravages of rust and corrosion.

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METAL WINDOWS

Member of the Metal Window Association

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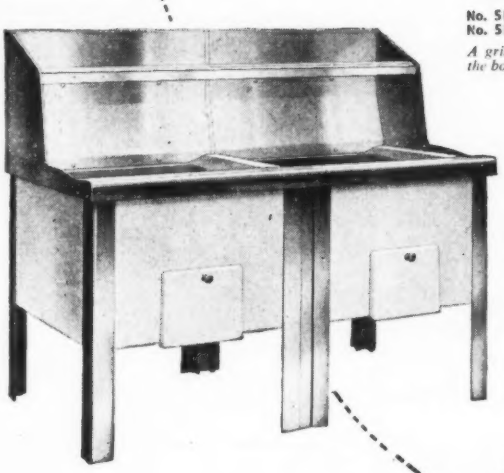

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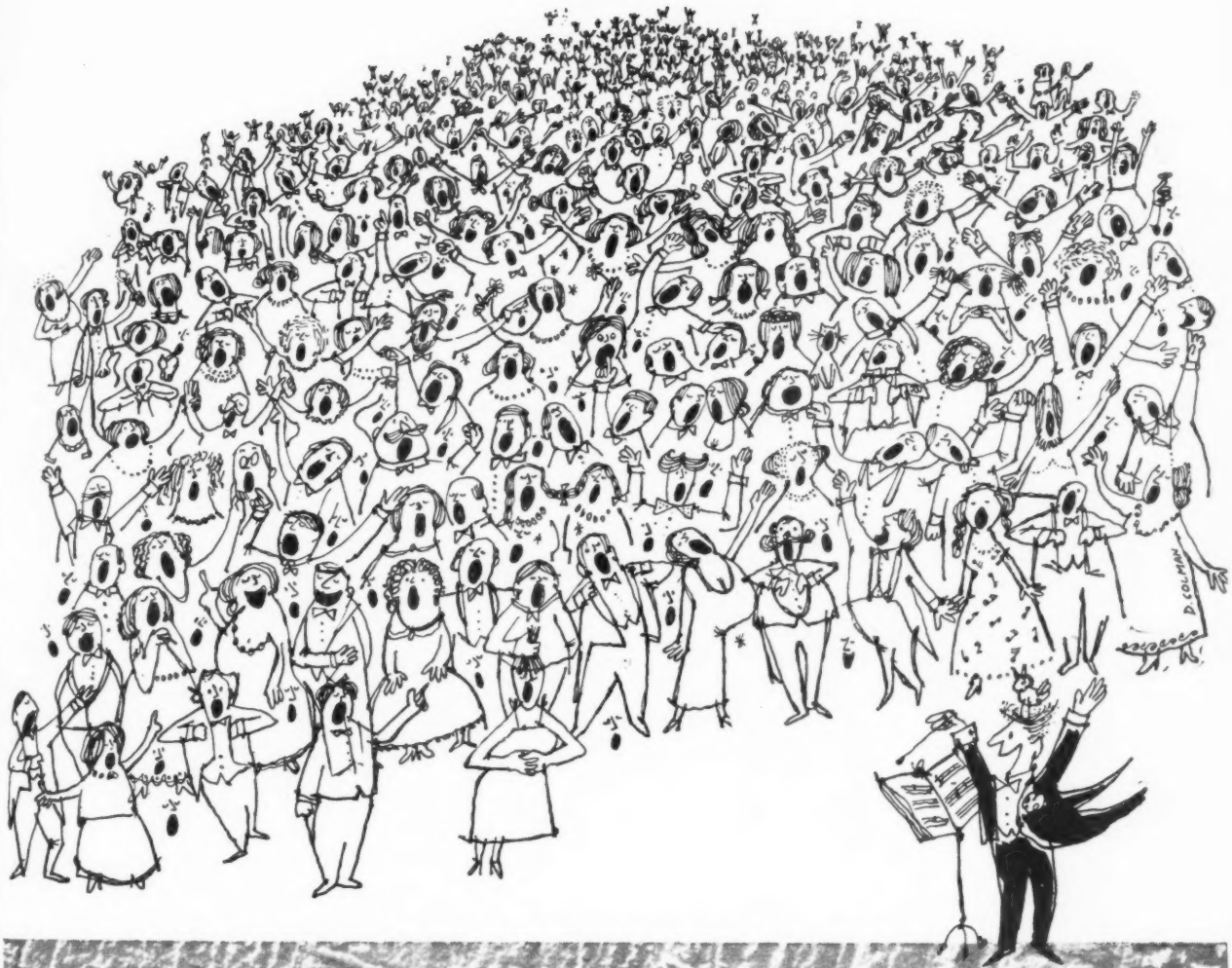

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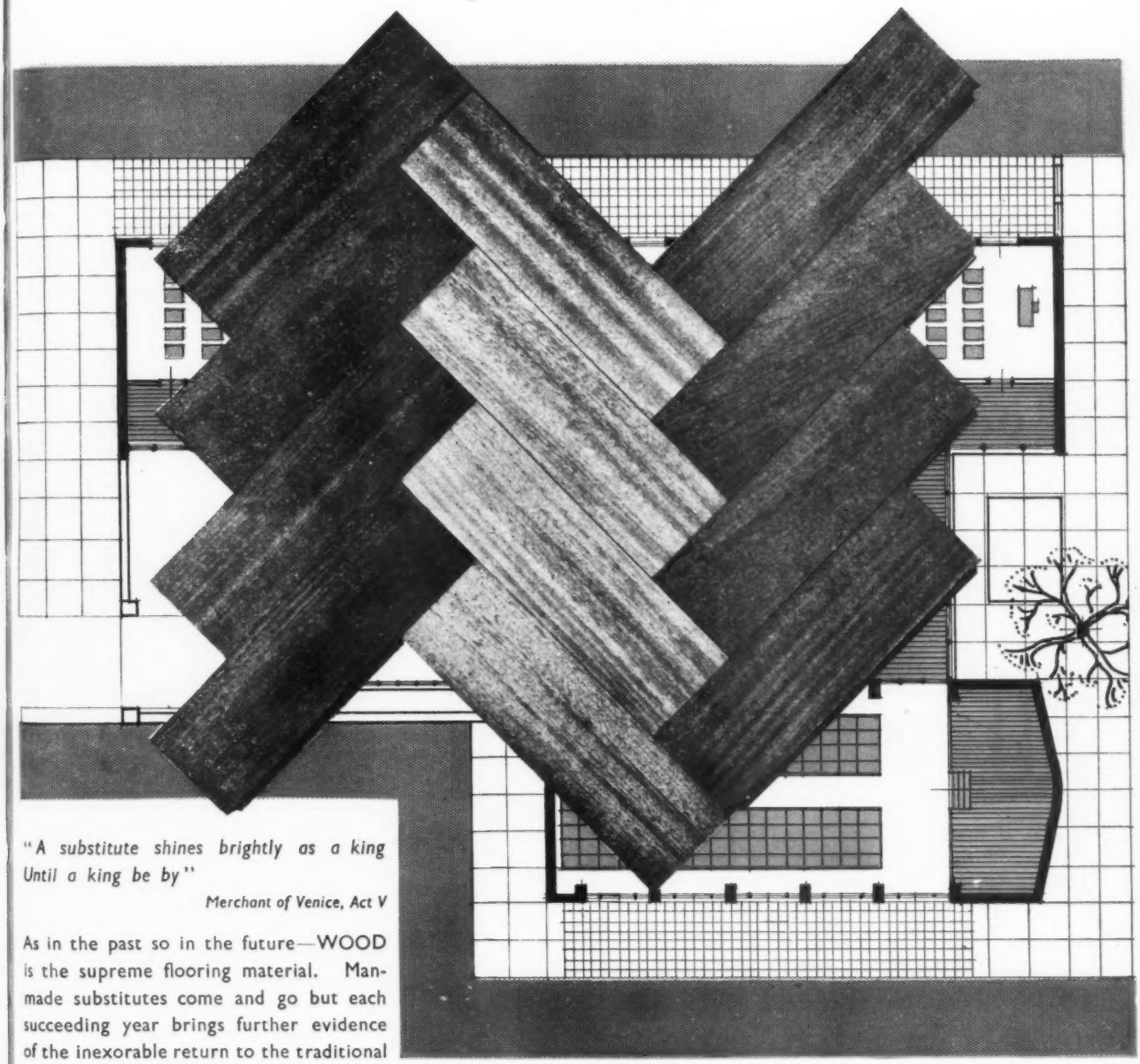

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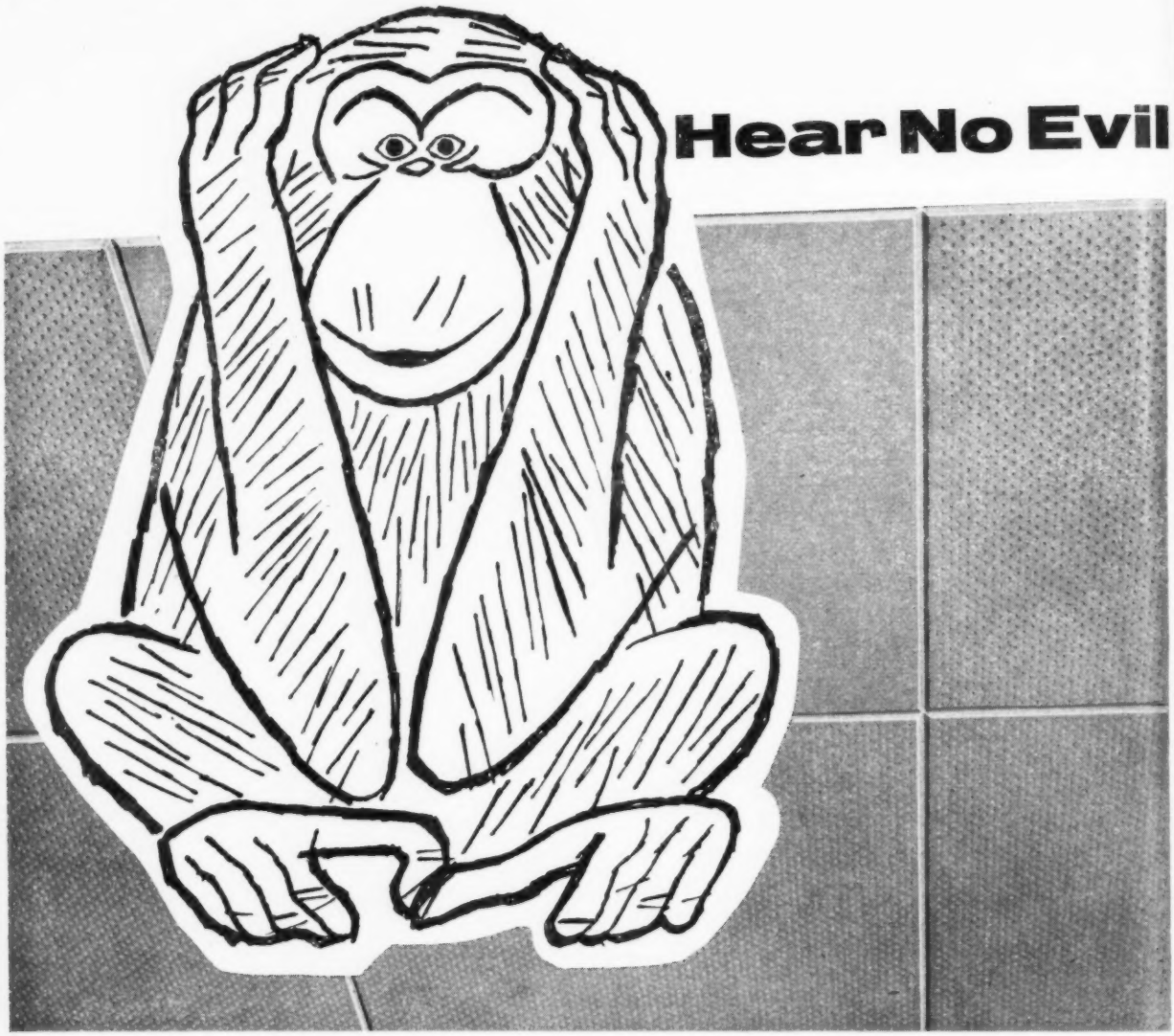

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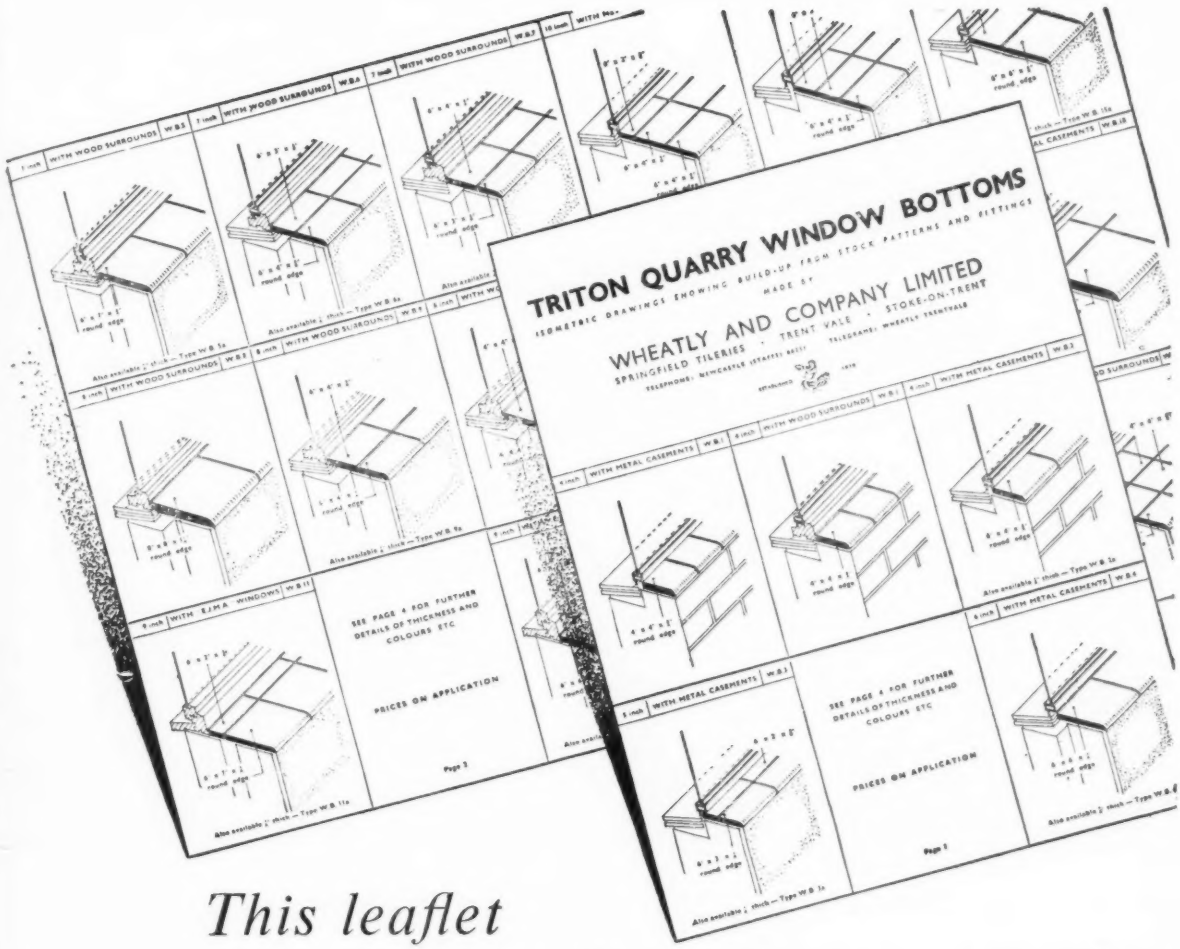

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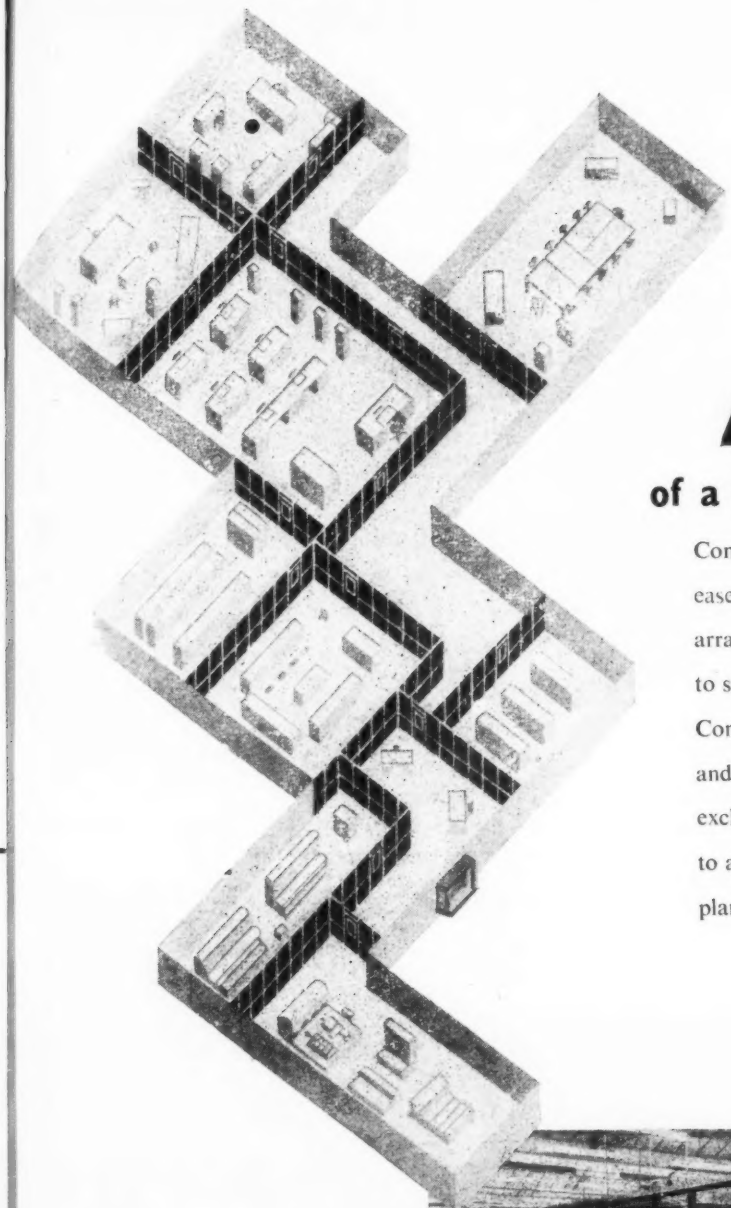

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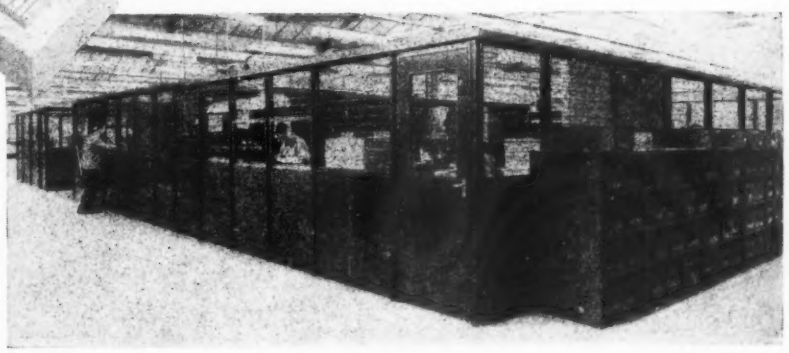

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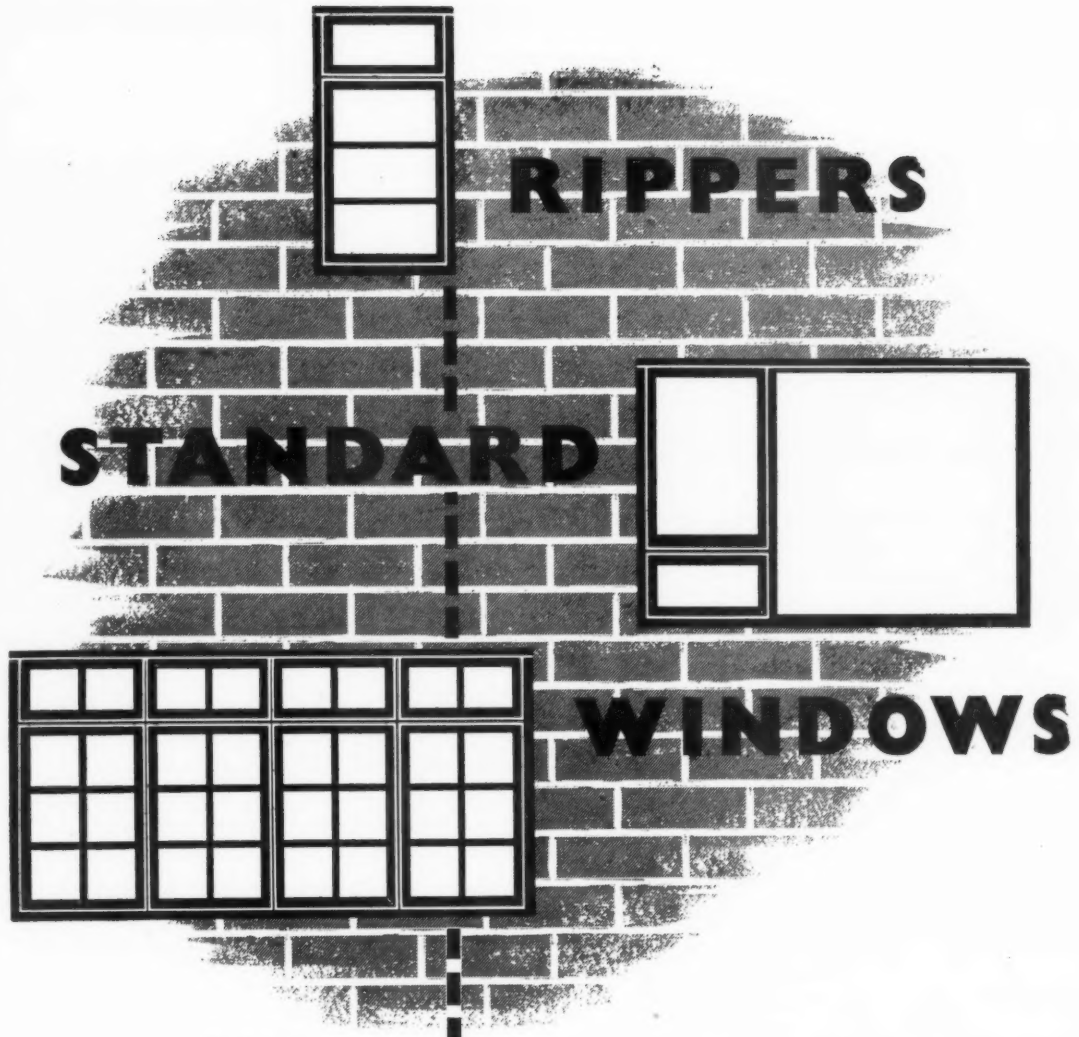

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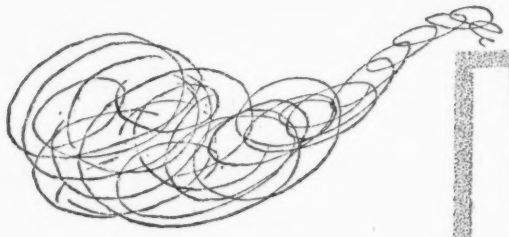

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THE ARCHITECTS' JOURNAL

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Building for Atomic Power Plant

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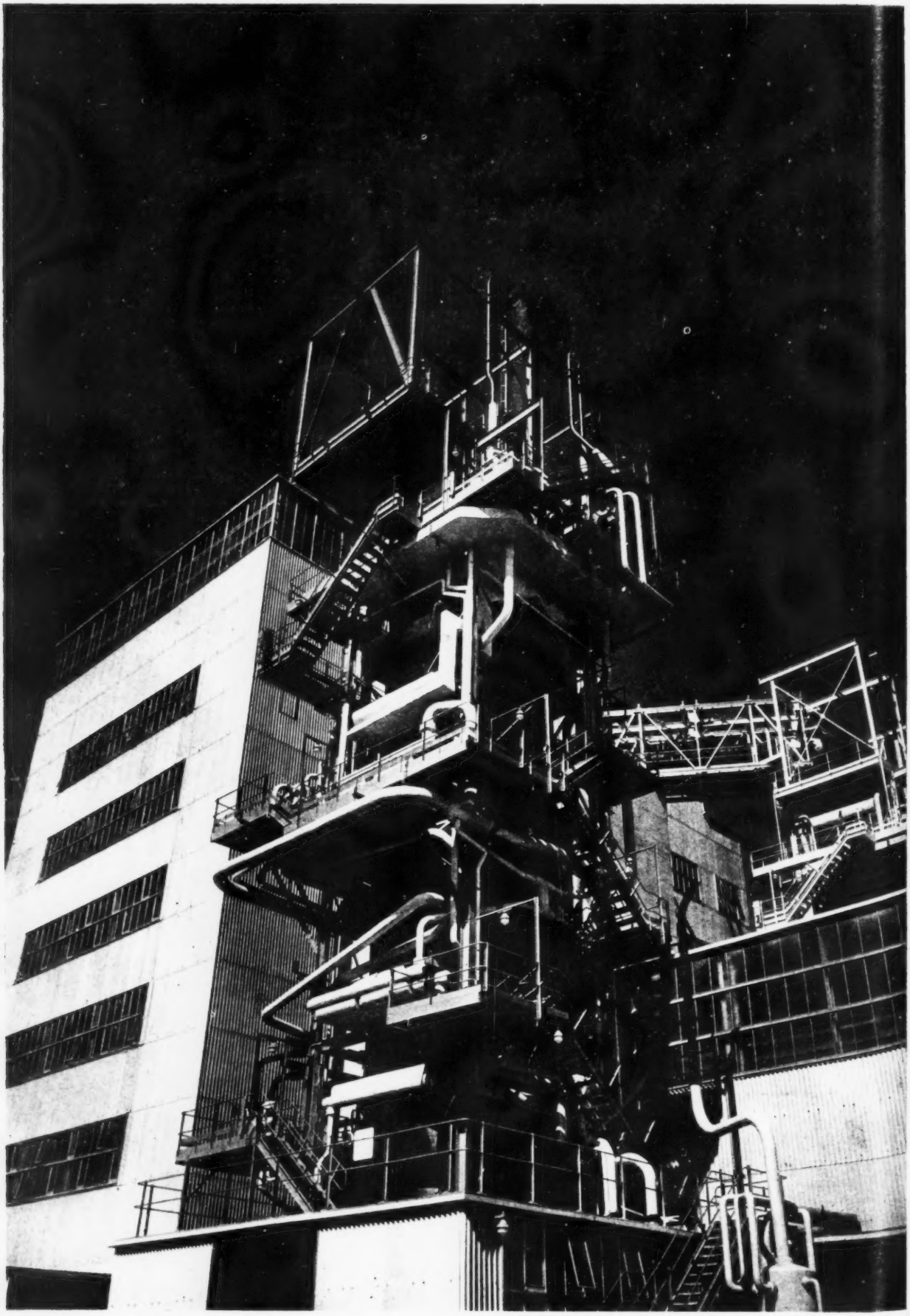


ARTICULATION: THE FIRST STAGE *Opposite we show a photograph of the Calder Hall Reactor with a heat exchanger in the foreground. At first sight it may look to you just another industrial mess. But though this is not evident in black-and-white, the unruly elements in this masterly piece of engineering improvisation have been picked out in different colours. The structural steelwork and balustrading is vivid red, the pipework is light grey and the heat exchanger itself is black.*

This may seem a very modest and (literally) a superficial achievement: but it represents the important first stage towards rendering this class of work visually intelligible—and hence humane. It is a welcome sign that the architect is at least "present" to this extent in the venture of building for atomic energy. Perhaps when next we come to devote a special issue to this subject the respect which the architectural staff enjoy with their engineering colleagues will have deepened still further and will enable them not merely to articulate with colour but to produce a genuine order—*in fact as well as in appearance.*

BUILDING FOR

ATOMIC

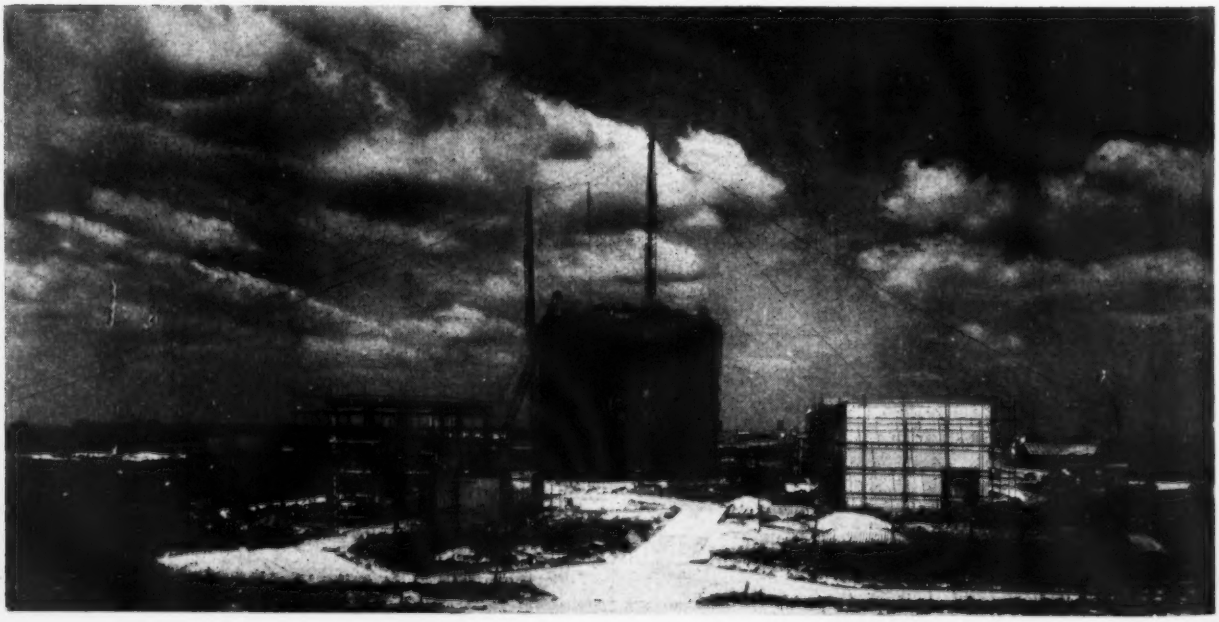
POWER PLANT

On October 16 Her Majesty the Queen opens Britain's first atomic power station, and by turning a switch will cause the first flow of atom-produced current into the national grid. This therefore seems a good moment to publish a special number on "Building for Atomic Power Plant." The purpose of this is threefold. First, to make a critical assessment on the considerable volume of building (some sixty million pounds worth) which the development of atomic energy has required during the last ten years or so, almost all of which (because of the security regulations) has hitherto escaped the net of architectural journalism. Second, to describe the technical problems—such of them, at least, as affect the architect directly—inherent in this class of work and hence to illuminate the part of the architect in the atomic building team. Third, to give our architect readers in their capacity as members of a cultured profession some insight into how atomic energy is produced. It was partly with this third and relatively humble objective in mind that we decided that all contributors to this issue should themselves be architects. The main part of this special issue has been written by W. A. Henderson, a senior partner in Farmer and Dark, a firm which has long been concerned in the design of coal-fired Power Stations—which we judged

to be the building type most nearly allied to Atomic Energy. While T. L. Viney and R. S. Brocklesby, who are respectively Deputy Director, Works and Construction; and Chief Architect, Industrial Division of the U.K. Atomic Energy Authority, have added a description of the Calder Hall Reactor and of how it was built.

Where *does* the architect stand in building for atomic energy? As W. A. Henderson points out, this class of work does not differ in kind from many other classes of industrial architecture insofar as it is nothing new for the architect to have to house some process which he can never fully understand. Also it must be remembered that his position at the start of this wild rush of construction (for that is what it was) was inevitably determined by the ideas of him which prevailed at that time—i.e. as a man called in at the last minute to make a structure look seemly. Though we may not, on looking through this issue, be greatly impressed by the more " architectural " buildings (they are very like what the rest of us were doing at the time) and though we may feel of the others—the " free standing plant " and the " plant buildings "—that they do not show that particular quality which is the sign of the full and effective presence of the architect in the team, it is probable that the profession at large owes much to the architects who have been working on these sites. In the rough and tumble of these ten years they have commanded more respect from their engineer colleagues than is usual on sites where engineers properly have the initiative, and that this has resulted in their earlier, fuller participation. The architect is instinctively an aesthete, but society will only let him be this in proportion to the confidence it feels in his technical knowledge and his entrepreneurial skill.

View of part of the site of the Harwell Research Establishment with the still unfinished heavy water reactor DIDO in the foreground.



Building for atomic energy

by W. A. Henderson

Numerous articles in the Press, and a number of official publications* have described British achievements in the field of atomic energy since the war as well as plans for the future particularly in the programme for nuclear power.

The official reports have dealt in the main with the research and production achievements and little mention has been made in them of the problems involved for the building team.

Now that the security curtain has to some extent been lifted it is possible to try to make an evaluation of this decade of unpublished building and on three counts: firstly, it is time that credit was given to the efforts of the architects, engineers, and site staff, under MOW and later under AEA in the erection against minimum time programmes, and in spite of inevitable changes of client requirements of over 1,000 buildings costing upwards of £60 million—a sizeable proportion of the national building programme during the period; secondly, it is possible to consider the trends so far in building for the atomic industry in the light of general trends in building today; thirdly, it should be appreciated that now that the advantages of Nuclear power and equipment are to be made available to industry, the problems of building for it become a new industrial commitment in which the architect has a part to play.

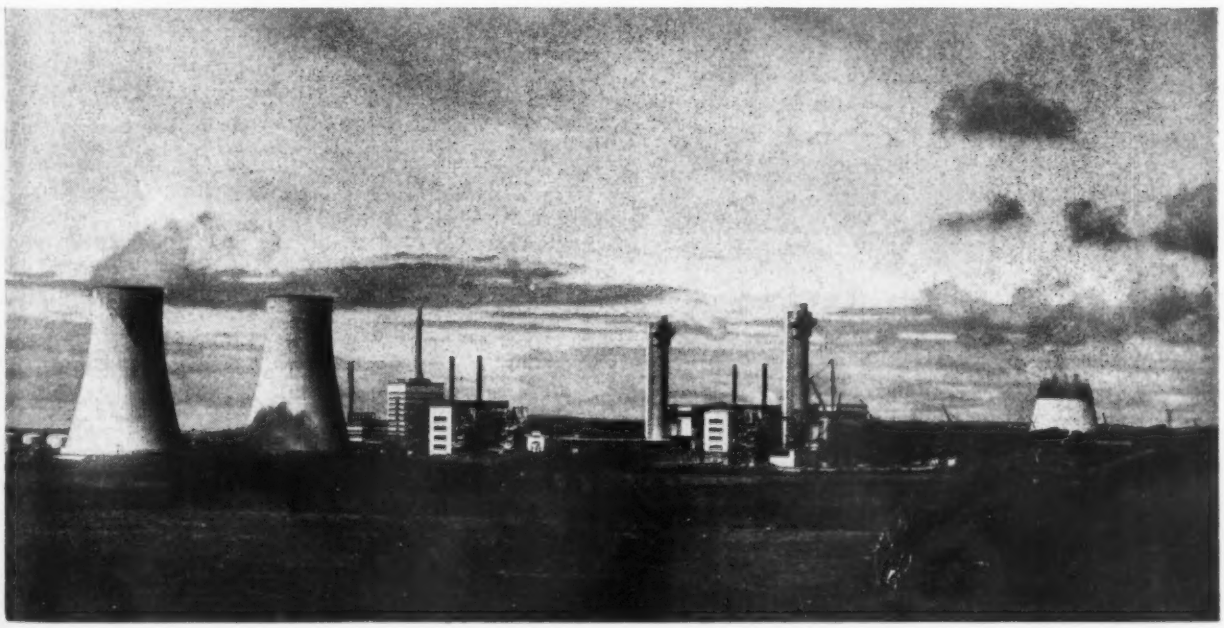
* *Harwell. The British Atomic Energy Research Establishment.* HMSO, 1952 (6s.). *Britain's Atomic Factories.* HMSO, 1954 (5s.). *A Programme of Nuclear Power.* HMSO, 1955 (9d.). *Atomic Energy Research at Harwell,* by K. E. B. Jay. Butterworth Scientific Publications (5s.). *The Civil Engineer and Britain's Atomic Factories.* Inst. of Civil Engineers (3s.).

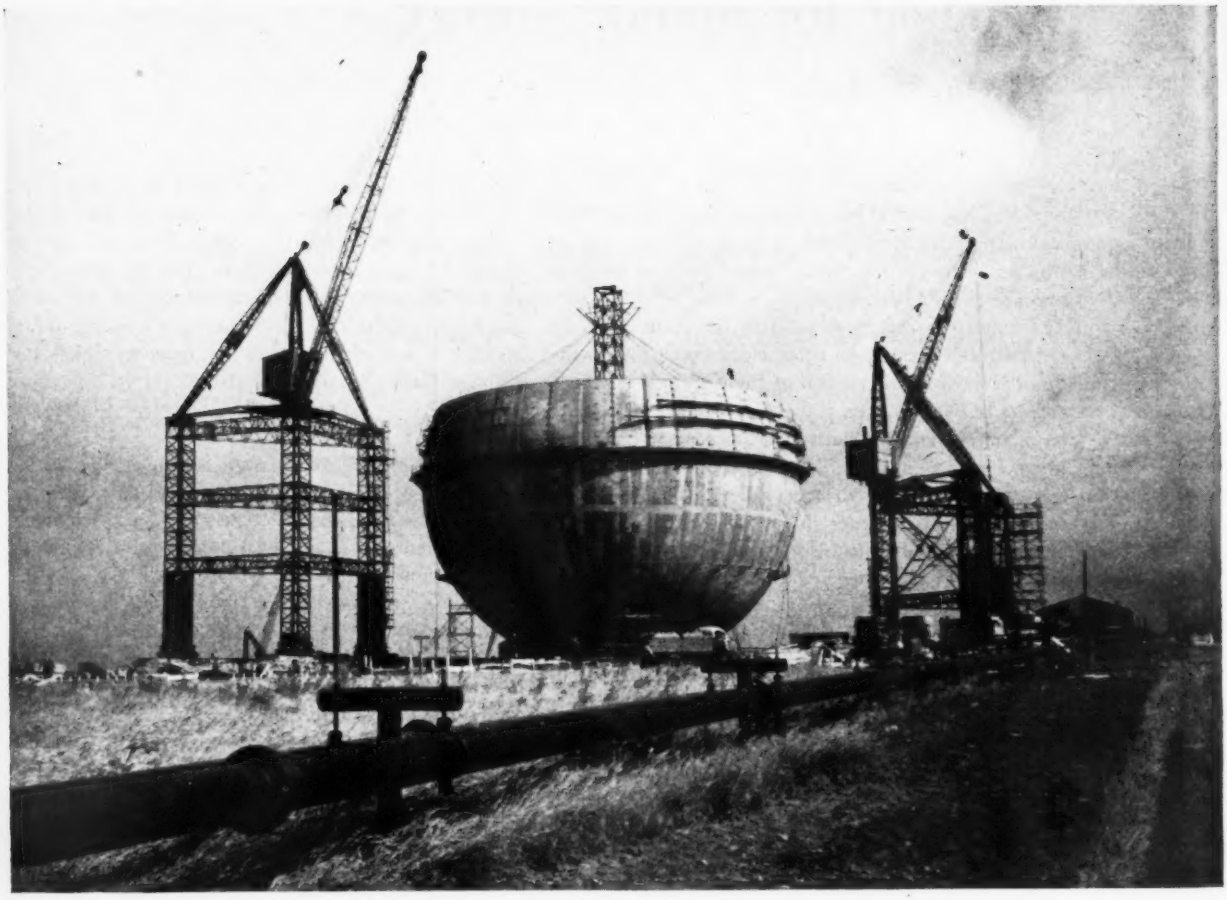
HISTORY

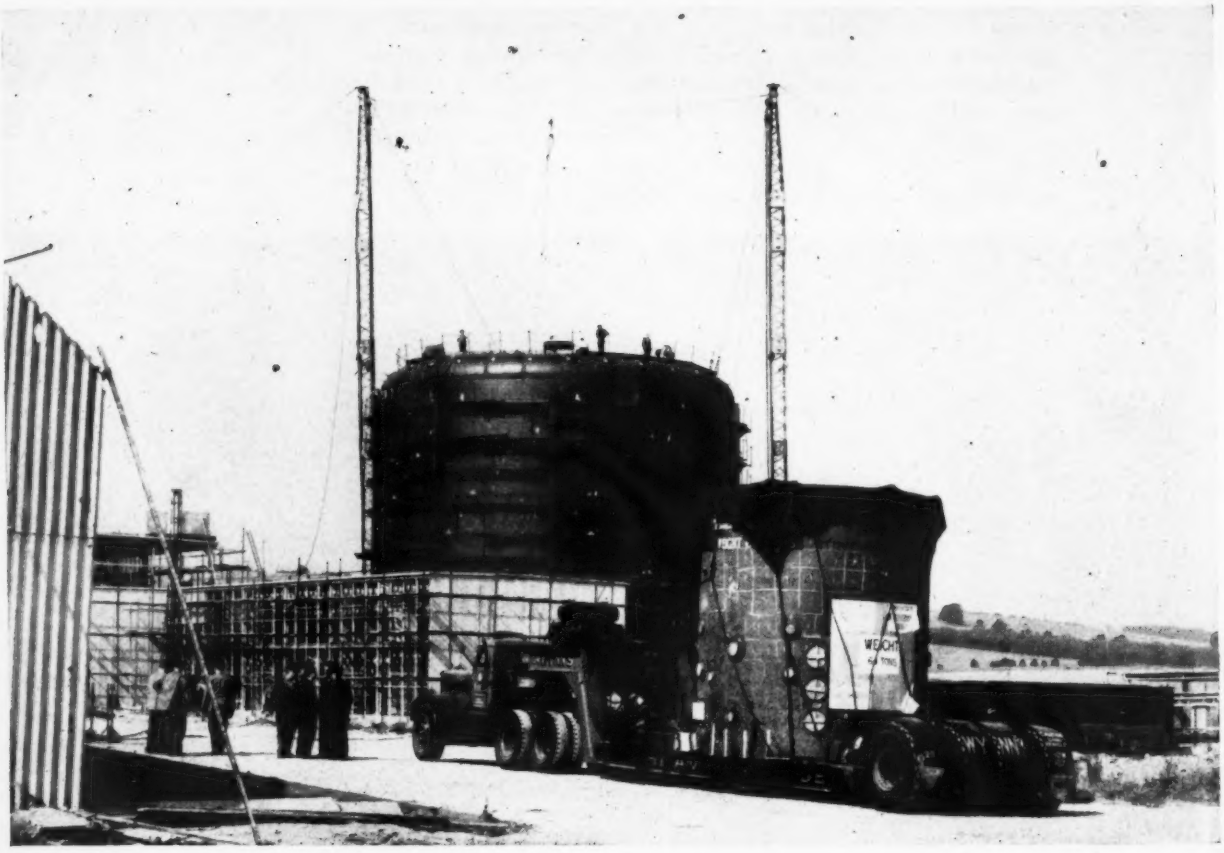
The history of the growth of the atomic energy organization has been covered in detail in *Britain's Atomic Factories,* by K. E. B. Jay, B.Sc., but the following is a brief summary of the background to the building programme to date.

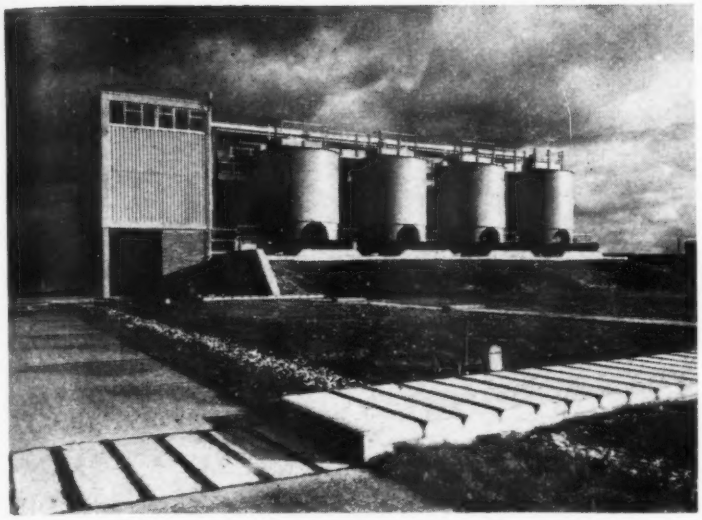
Work on Atomic Energy research was initially the responsibility of DSIR. When, in October, 1945 it was decided as a matter of national urgency to extend research into industrial production, the responsibility was transferred to the Ministry of Supply, whose Division of Atomic Energy was set up in January, 1946, Sir John Cockcroft being the Scientific Director of Atomic Research and Sir Christopher Hinton Deputy Controller of Production. This organization

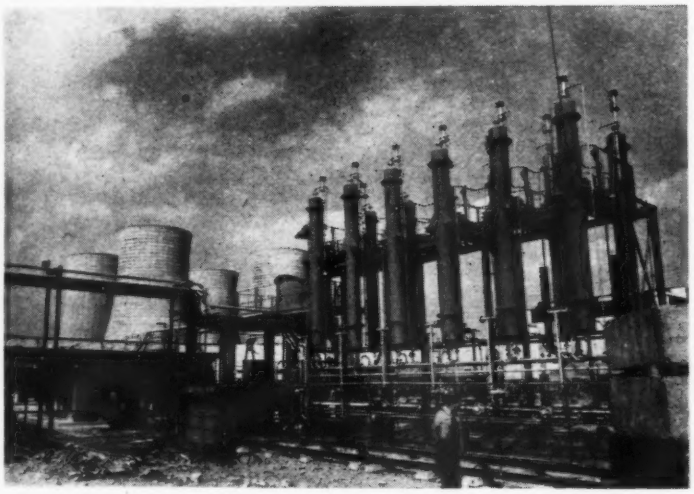
General view of the Calder/Windscale sites. The Calder river (which cannot be seen in the photograph) separates the sites. The two cooling towers on the left are at Calder. The tallest of the blocks immediately to their right is the Chemical Separation Plant on the far side of the river at Windscale. The lower building in front of this with the paired chimneys and the similar building further to the right are the two Calder Hall reactors (the one on the left is now operating). The two massive vertical features right centre are the ventilating shafts at Windscale.











Exposed plant elements : *On the opposite page are two photographs which show progress to date, above, on the fast reactor at Dounreay (which, when completed, will be in the form of a sphere), and below, on the heavy water reactor (named DIDO) at Harwell. This page, top, a trade waste pre-treatment plant at Aldermaston. Above, scrubbers (filtering apparatus) on the diffusion plant at Capenhurst.*

was subsequently taken over in August, 1954, when the United Kingdom Atomic Energy Authority was constituted as a non-departmental organization. Throughout there have been, and remain, three principal groups:

Research group: under the direction of Sir John Cockcroft, centred on the Harwell Research Establishment and also covering the Radiochemical Centre at Amersham, Harwell is the "university centre" for the atomic industry and as such is primarily concerned with scientific research and development: the capacity of its equipment is used in addition for commercial processing (e.g. the irradiation of medical equipment made at the Radiochemical Centre at Amersham).

Weapons group: under Sir William Penney, centred at Aldermaston (Weapons Research) and covering additional establishments at Woolwich and Fort Halstead.

Industrial group: under Sir Christopher Hinton, centred on Risley and covering the Production Establishments at Springfields, Windscale and Capenhurst and following on these the new prototype power stations at Calder and elsewhere. Risley is the headquarters of production development, namely the translation of scientific method into industrial process and structure, and, as such, now the general information and control centre for the application of atomic power to industrial purposes in the future. Risley controls three main factories for nuclear "fuel":

SPRINGFIELDS (Lancs.): the "foundry" at which uranium ore is converted into metal rods for use in atomic piles or into uranium hexafluoride* for further processing.

CAPENHURST (Cheshire): a "refinery" which separates the isotopes of uranium, producing material enriched in uranium-235, by gaseous diffusion.

WINDSCALE (Cumberland): a "refinery" which converts uranium metal into plutonium by means of atomic piles and chemical separation.

These three "factories" together form the primary source of supply of the isotopes required both for arming atomic weapons, and for energizing power plants or other industrial or scientific plant. They supply and deliver fuel elements to the user establishments in the form of radioactive cartridges, sheathed uranium rods or gas, and also receive back partly spent material which they re-process for further use. The factory processes involve a considerable consumption of electric power at present supplied from the grid, and their by-products, in the form of heat, have so far had to be largely wasted.

As opposed to this, in the application of nuclear fission to the generation of electric power, the object is to use the heat from nuclear "fuel" and if possible to produce more "fuel" in the process. The production of electricity from Calder Hall power station this year will be a national landmark in the application of Atomic energy for power production, as was the Monte Bello explosion of October, 1952, in its application for military purposes. These, and the many other applications achieved or under investigation, have been dependent upon the success of the primary target—the construction and operation of the basic research and production establishments.

Responsibility for Building Design

Up to the establishment of the United Kingdom Atomic Energy Authority in August, 1954, all building has been the sole responsibility of the Ministry of Works under its Director General, Sir Charles Mole. Thereafter the Industrial Group set up its own Architects Department with R. S. Brocklesby (who is one of the joint authors of the note on the Calder Hall power station which follows this article) as Chief Architect. Nevertheless, if we make the important exceptions of Calder Hall and Dournreay, most of the work discussed in this article has been carried out under the auspices of the Ministry of Works and, to save long-windedness, we refer only to MOW when discussing matters of organization.

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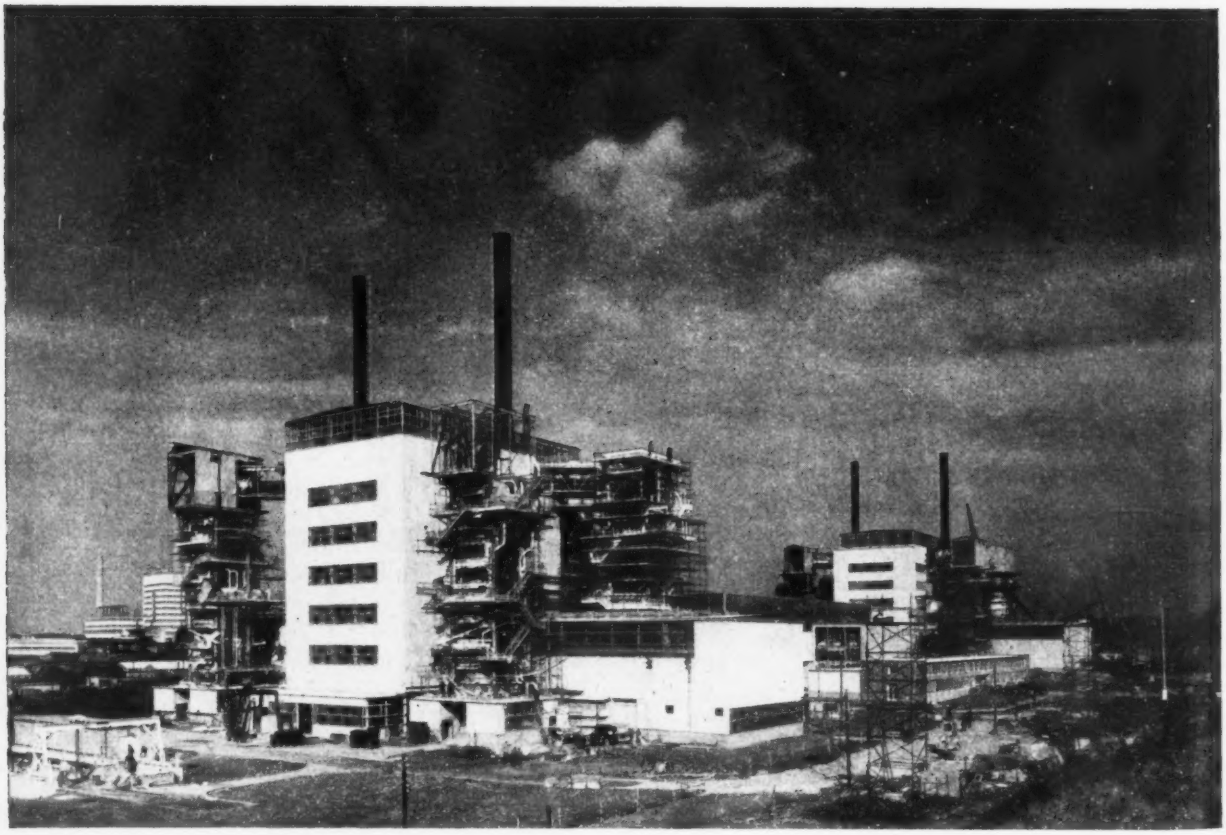
* See Glossary, page 534.



Plant buildings: *Buildings where "plant and building are so fused together that the building is part of the plant." Opposite page, top, ventilating shafts at Windscale. Projections near the top represent a costly afterthought characteristic of building for atomic energy in this pioneer phase. At the time when the shafts were already being built it was decided to add additional filters 360 ft. above ground level, weighing 2,000 tons each. The fin running up the side encloses lift shafts. Opposite page, below, general view of the first two reactor power stations at Calder Hall. How these function and how they were built is described in the note which begins on page 526. The sheeting at the top of some of the heat exchangers (i.e. the pipe-ridden openwork towers which surround each main block) is temporary and was installed to give protection during the installation of the tubes.*

The Ministry of Works under its Director General Sir Charles Mole, and in collaboration with these three client groups, has been responsible for the design and construction of buildings, general plant, equipment and fittings at all these establishments, as well as the site erection in certain cases of scientific research and production equipment (e.g. development of erection techniques peculiar to reactors). The value of work built has been in the approximate proportion of Research Group, £14 million; Weapons Group, £21½ million; Production Group, £27 million.

Reduced to the simplest terms, the building problems have devolved on the translation of laboratory scale experimental processes into terms of large installations.

In effecting this translation the relative range of responsibility of the Ministry of Works has varied with each of the three client groups. The Production Group is largely composed of electrical and mechanical engineers, who make their own decisions on the design and layout of plant, and have also had distinct views on the types of structures which they require to house and support it; as a result their requirements have been in the main specific. The Research and Weapons Groups, on the other hand, are essentially composed of scientists, and these have looked to the MOW architects and engineers for the translation of scientific requirements into constructional forms. This has given the MOW design teams, on the latter projects, a greater responsibility, and wider scope of research, not only on the design of buildings, but also on that of a great range of plant and service problems.

In undertaking this vast pioneer programme of construction, the Directorate General of the Ministry of Works had administrative and technical precedent, and experience. Large-scale constructional programmes were first handled by HM Office of Works in the first world war. Since 1936 over £500 million of building and engineering works have been constructed and equipped by the MOW for government departments, including experimental research establishments; in particular there was the programme of Royal Ordnance Factories, of which the design and construction has certain general points of similarity with that of the atomic programme, the Ministry of Supply also being the client department.

In both cases, the Ministry of Supply has provided the detailed functional requirements, whilst the MOW, working with them, has supplied the design and has undertaken the construction, with the exception that in the case of certain specialist plant the MOS retains sole responsibility for supplying it complete, for erection only by the MOW.

The Classes of Structure

The sinister possibilities of nuclear fission and the mystery and apprehension which have surrounded its development, do not alter the fact that in terms of building it is simply another industrial process. If the details of the process are largely unintelligible to the average architect (including the writer) so also are those of many other industries on which architects work already. The essential is that he should make himself familiar with the tasks of the operations used by the scientists. The problem of design for the Atomic Industry as compared with other industries has differed in degree rather than in principle and in general the following categories of building types, normal to industry, seem to hold good:

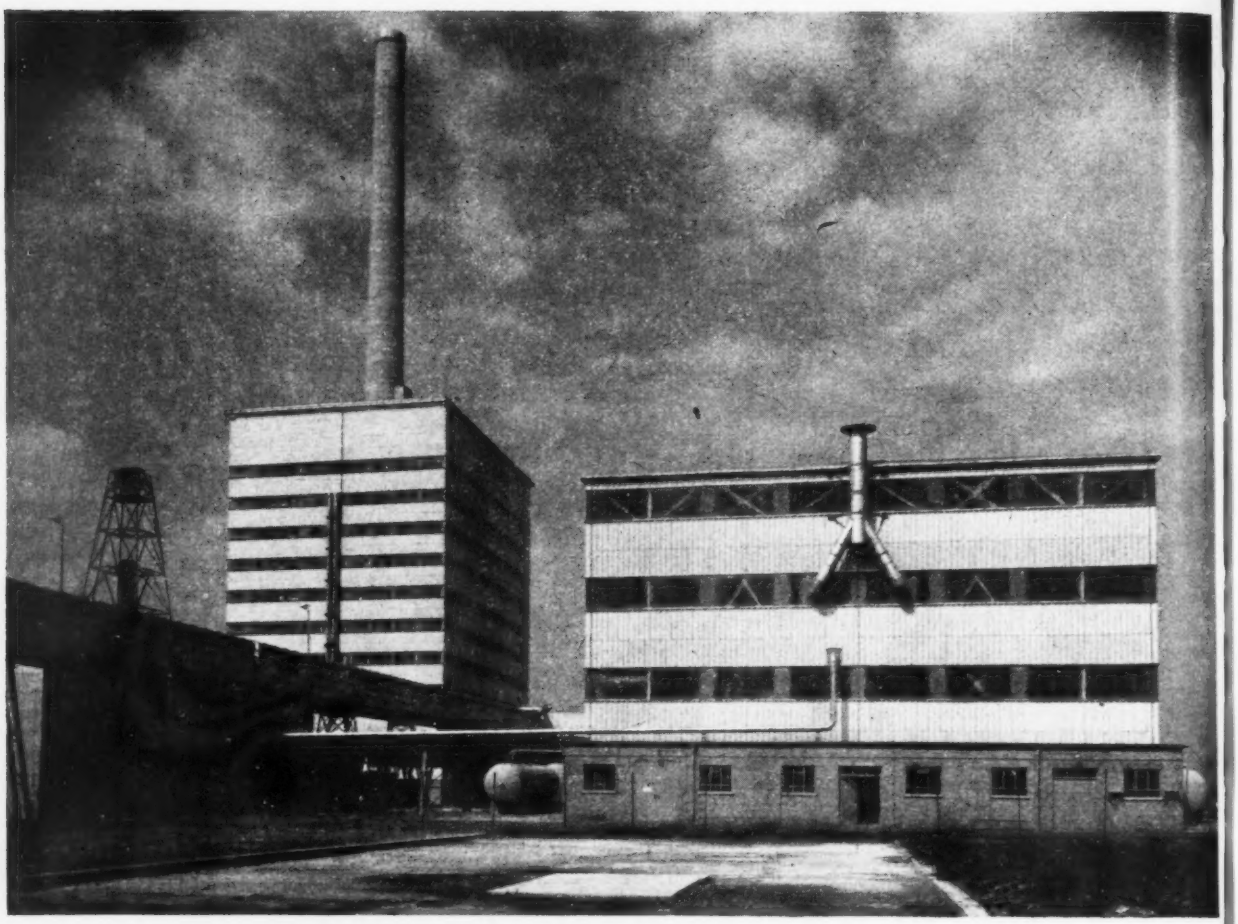
1. *Exposed plant elements:* complete and obvious in themselves.
2. *Plant buildings:* those where plant and building are so fused together that the building is part of the plant. Generally expressive of their function and largely unadaptable.
3. *Plant-enclosing buildings:* envelopes enclosing a variety of plant and generally allowing alternative arrangement of it—largely inexpressive of the process enclosed.
4. *Services:* Dependent on the process involved.
5. *Buildings for human needs:* administrative and welfare buildings of human scale.

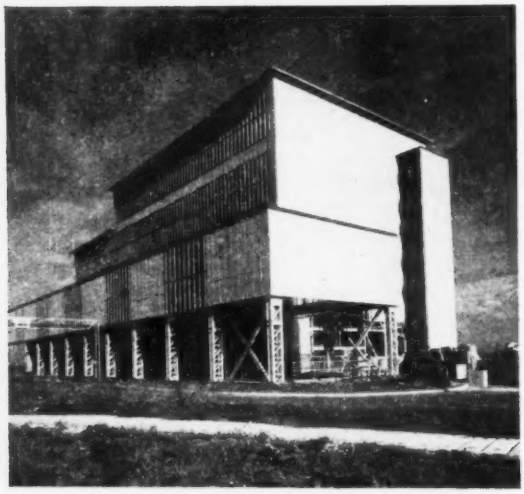
Position of the Architect

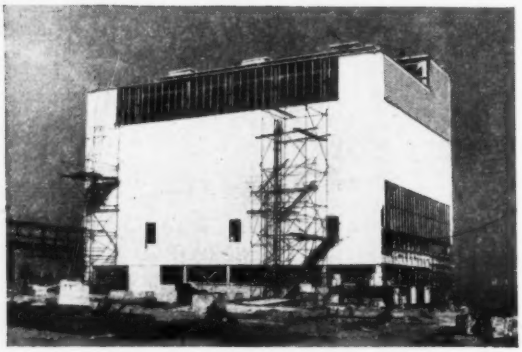
The minimum task of the design team in industrial work is to resolve the layout, circulation, grouping and construction of these elements and their hybrids to meet the requirements of plant process and human operation of it with economy, order and speed. A higher aim in addition might be defined as that of achieving a sense of the whole, a total which is more than the sum of its parts, and which may deserve the title of industrial architecture.

There is good reason why this is so rare. Firstly, the design programme is seldom static; except in the case of a standardized production unit, the designer must work in the knowledge that individual buildings and the layout as a whole may be changed or extended at any time. He must also accept the anachronism that whereas structures must be ready to receive plant, the final details of that plant, together with its exact loadings and service runs, are generally not to be had until the structure is in an advanced stage of design if not of construction. There is no field of building today in which the precept of complete information followed by complete solution is more unrealistic, or where practical instinct is more essential, than in building for plant.

Secondly, the value of specialist plant of all sorts may well exceed the value of building by ten times, so that the economics of plant layout, and the expediences demanded in its erection, are the dominant factor and



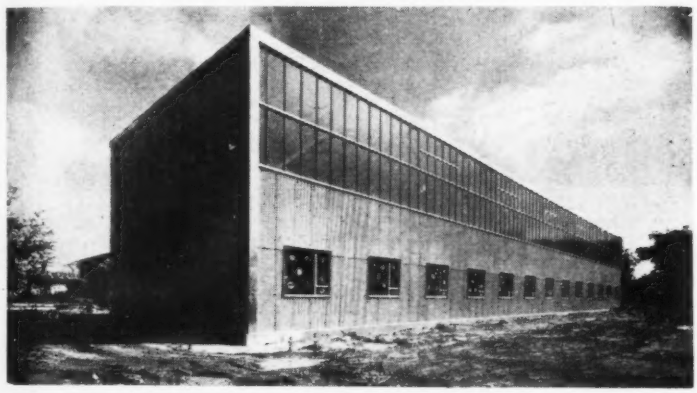


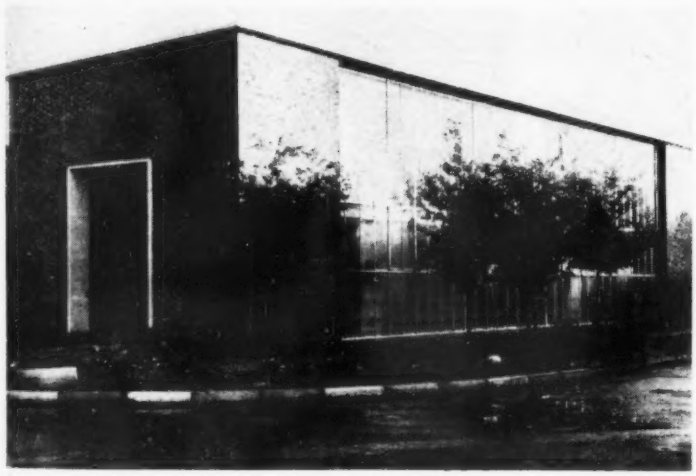


Plant-enclosing buildings: *The buildings on these two pages belong to the class described as "plant enclosing." They are envelopes for plant and as such are unexpressive of the process. Buildings on this page are, above, the Chemical Separation Plant at Windscale; left, Chemical Extraction Plant at Harwell and below left, the Boiler House at Capenhurst. Opposite page, from top to bottom: the General Stores, and the Plastics Development and Workshop, both at Aldermaston; the Nitrogen Plant at Harwell.*

the chief say in its disposal on the site rests with the various plant specialists. These, being essentially experts, are for that very reason comparatively unused to relating their particular subject to other subjects or to the consideration of the whole. Whilst the architect, the only member of the team who is specifically trained in the humanities and who should by training be responsible for the total balance, is in fact directly in control of the least costly part of the work.

If, to use a simile, the architect on civil buildings can hope to be in the position of a marksman, and calculate all conditions before attempting to hit a given target, on large industrial projects he is more like one of a boat load of anglers jointly playing a fish of unpredictable size and behaviour.





Under these conditions the difference between success and failure is marginal and depends on joint effort rather than on a preoccupation with professional precedence. The architect in the team at best represents the overall design conscience, as such, at times, an inconvenient voice, and one all too easy to smother on grounds of specialist expediency. He can only get respect from his powerful colleagues by showing real sincerity of purpose, and avoiding any taint of being himself a specialist in those fashions and effects for which he has long been notorious and with which the engineer still associates him.

If these general principles apply to any industrial project, they have applied in the atomic projects on a scale without precedent.

Inherent programming difficulty

Because of the national urgency, the overall programmes, from research laboratory to application, were telescoped to minimum timetables, and these in their turn were broken down into many others, to include all stages from basic scientific research to production.

The implications of this in terms of building meant that it was a commonplace for the design of structures to be started with only outline knowledge of the plant to be housed, for the simple reason that the plant design engineers were waiting on the scientists' findings and the scientists in turn dependent on the completion of other installations for the finalization of their research. Just as plant design had to be altered at short notice as a result of new research findings so, in turn, had structures, and these were often of great density and strength. An extreme example of this was the decision to provide additional filters in the exhaust air system of the Windscale Reactor buildings at a time when the ventilation shafts were already under construction ; filter plant structures, weighing 2,000 tons each had to be added at the top of the shafts 360 feet above ground level and lift shafts added to the sides, a major engineering feat producing a remarkable if freak design.*

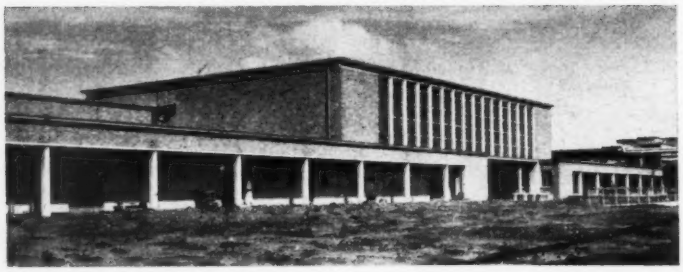
The programme involved breaking new ground in all branches of design but, if experimental, it had to be experiment with no possibility of failure. Sir Christopher Hinton's remark that "on this work it is important to be successful rather than clever" summarises the brief.

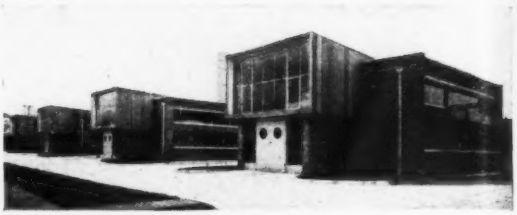
Protection against radio activity

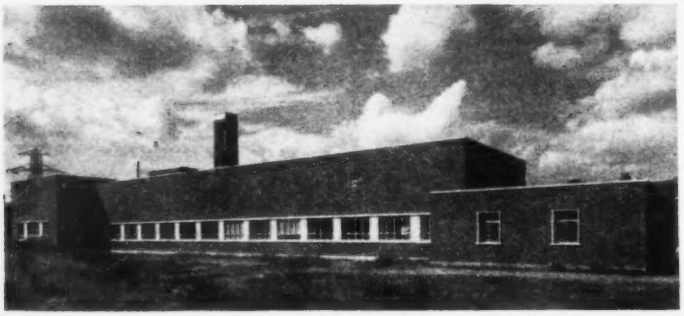
Guaranteed protection against radio activity has been the over-riding factor in every aspect of design and administration. National and regional considerations are involved in the choice of sites and the treatment and disposal of effluent and exhaust air. Planning for circulation of personnel, plant and services both in site layouts and building groups, and both during construction and in use, had to be strictly related to dirty, clean, process and "hot" areas, and to the requirements of health physicists and medical officers. The traditional conception of building is turned inside out, problems of keeping weather out becoming insignificant as compared with those of keeping radio activity in. This means preventing any possibility of escape not only of radio-active rays through plant shielding but of any particle of untreated radio-active dust or waste from inside any installation which is subject to any degree of contamination whatsoever. As a result, not only process buildings but also research and welfare buildings have a high proportion, often more than 50 per cent., of their cube devoted to "protective" plant in the form of air conditioning, shielding, remote control systems and monitoring devices, whilst the Health Physics and Medical Departments which back up these protective services in turn require sizeable laboratories.

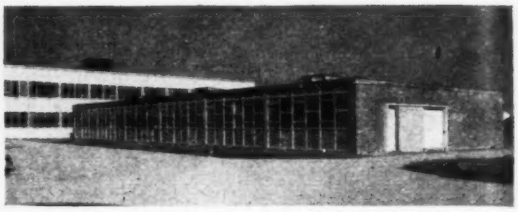
The work therefore is characterized by elaborate ser-

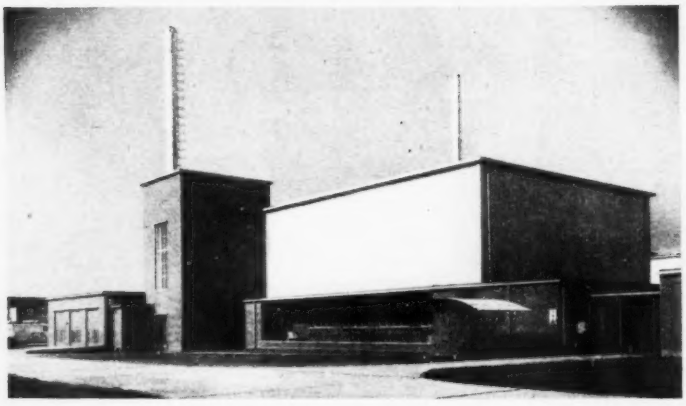
* See Paper by D. R. R. Dick, B.Sc., M.E.C.E., in the *Structural Engineer*, November, 1954.











Laboratories: *The buildings illustrated on this page, as they are all of broadly similar function, could well serve as a record of architectural fashions during the last ten years. The top building on the left, the Chemical Control Laboratory at Windscale, is axially planned in the grand manner. Next, below, is the Radioactive Chemical Laboratory at Teddington, with an asymmetrical, balanced composition and the long horizontals reminiscent of Dudok. Below this is the Laboratory at Aldermaston where a similar architectural vocabulary has been used with two contrasting materials; while the multi-storey Research Building at Harwell at the bottom shows the fusion of this planning ideal with the typical post-war lightweight modular framed building. The stylish little Medical Isotope units which head the second column could only have been designed in the era of the Festival of Britain; while the two long, low buildings below, the Electronics Laboratory and the Process Research and Development Laboratory, both at Aldermaston, belong as certainly to the era of the schools programme. Lastly we have the Test Laboratory for effluent at Aldermaston which grapples with a visual problem which is repeatedly cropping up in the atomic energy programme.*

vicing, by the occasional demand for remarkable feats of erection (for some of the equipment is exceedingly heavy and cumbersome) and, in the later stages of construction, by the need to observe elaborate precautionary measures on site. What these mean in terms of building operations can be judged by the account of the Calder Reactor presented on page 526.

The planning problems have been considerable but the constructional implications of protection against radio activity have been much greater and here the building team have had to develop methods and achieve standards not previously attempted and often apparently contradictory in terms of accepted practice.

The methods used by the MOW to get the job done—in spite of these new problems, in spite of the confused state of building supplies during the period, and in spite of the complication of strict security measures—are a lesson in the problems of a vital operational programme. The principles used seem to apply, on a reduced scale, to the general building problems of the day.

Collaboration in design

The MOW includes within its own organization architects, engineers of all branches, testing establishments, quantity surveyors, site and progress staff and mobile labour force. All these work in joint collaboration and it is interesting to notice that the absence of segregation between the different professions was a precondition for success.

The other main factor was the insistence of complete programming from the start of every project, not only to cover the construction process but also to include precise dates for the receipt of information during the design process. Even if these plans had to be changed they were replaced by equally comprehensive ones, and this if necessary again and again. In general the architect has acted as co-ordinator on each project, including being present at all discussions and acting as a clearing house for specialist requirements.

At the start of any project, large or small, the architect and engineer meet the client to discuss his requirements. For a large and complicated project a design liaison office is set up within the client department to maintain day to day contact. Joint discussion between all parties at all stages has replaced much correspondence, and has saved much time.

A crucial problem, inherent in rapid development, was the decision when to finalize the design of any one installation.

Once finalized a strict time programme was set, to cover the phasing both of plant supply and erection, and of building construction ; both categories of effort were subjected to constant pressure by the Client Department.

The programmes were worked out in great detail, not only as regards programming of all trades on the site (sometimes down to one-day tasks) but also to cover the production and delivery of components and materials from the factory. To maintain these programmes meant having adequate staff on site, as well as progress men and inspectors ready to visit factories and sources of supply to anticipate a bottleneck. The natural reluctance of manufacturers with full order books to take on new and complex commitments, had to be overcome. Pressure on suppliers to maintain delivery dates had to be matched by equal evidence of keeping faith with them, so that no delays on site should appear to reduce the value of their efforts. Special diplomacy was called for where, for reasons which often could not be divulged, drastic alterations were called for on work which had already been largely completed.

Tendering was competitive to begin with, but the establishment of certain contractors on the various sites and the rapid expansion of the programme led to the substitution of a system of negotiated contracts at unit rates.

Site organization

The MOW site organization was in each case under the control of a Resident Engineer and a Site Architect working in collaboration, with a considerable technical, drawing office, and supervisory staff on the site itself. As opposed to traditional procedure, under which the General Contractor plans his own work and the Architect and Clerk of Works have only the power to approve or reject the results, on this programme all major decisions on the organization of the work were made by the MOW staff on the spot. Engineers and architects on the site worked out the process of building with the contractor in the same way that those at Design Headquarters designed the buildings with the scientist and plant engineer, and the progression of work from design to completion was not jeopardized by the gap between drawing office and site which is a problem on many projects today.

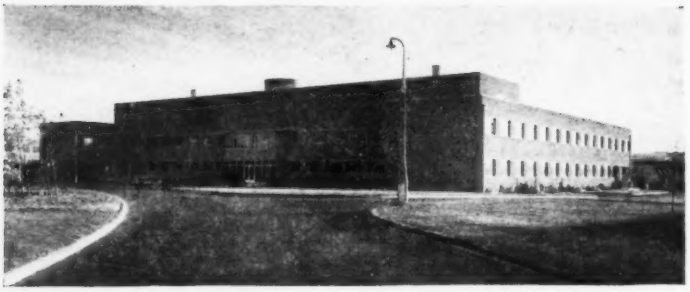
Where amplified drawings were called for in the course of construction, the site organization was often able to draw and issue them within hours if not minutes.

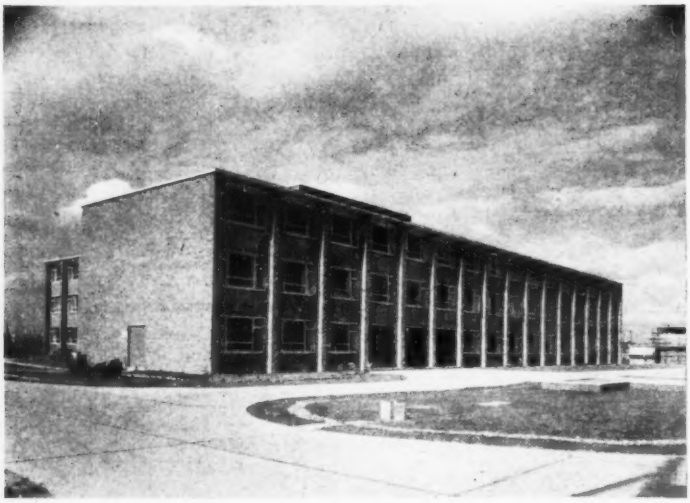
A familiar problem on buildings with complex services is that whatever the hold-ups on plant and electrical installation may be it is the building team that have the task of finishing off and as such carry the ultimate onus for any delay in completion. Various measures were evolved on site to overcome this ; for instance the prepainting of electrical cable trays was adopted, both to reduce final painting time and as an aid to recognition in erection.

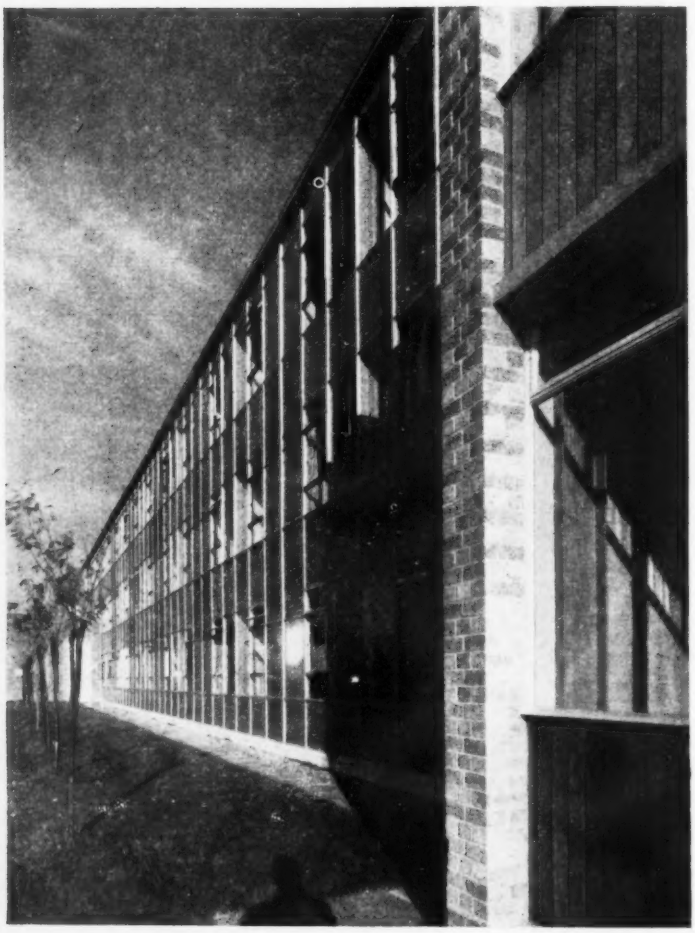
Supervisory staff were always in the centre of operations ; there were even cases where Clerks of Works were permanently stationed on stands, much like traffic policemen, each responsible for the work going on within their immediate range of vision. The quality checking of materials, particularly of concrete, and the testing of completed work was a very serious responsibility where radioactivity was to be involved.

Labour

This intense standard of supervision was reflected in a sense of purpose in the labour working on the sites even though this labour was often drawn from a wide area. The working conditions were often severe, par-







Office buildings: *Top left, Metallurgy building at Harwell. Centre left, Administrative building at Aldermaston. Bottom left, Theoretical Physics offices at Harwell.*

ticularly on exposed sites such as Windscale, but the work continued in all weathers. Apart from the prospect of continuity of work no special incentives or bonuses were paid.

For particularly difficult operations teams of fitters were trained and rehearsed in their jobs. An instance of this is the laying of the graphite blocks within the reactor shells. For this operation the working party have to strip in a temporary changing room inside the structure, have a shower, put on special overalls, boots and gloves and even face masks (since to sneeze on a graphite block will make it unserviceable) and then lay the blocks to a predetermined "drill" inside the completed steel vessel to which access is to be had only through the gas intake openings. (See page 533.)

Handing over

There was a strict sequence of handing over particularly on buildings designed for radio active use. When the finishing stage was reached a building or part of a building was screened off and declared a "CLEAN AREA."

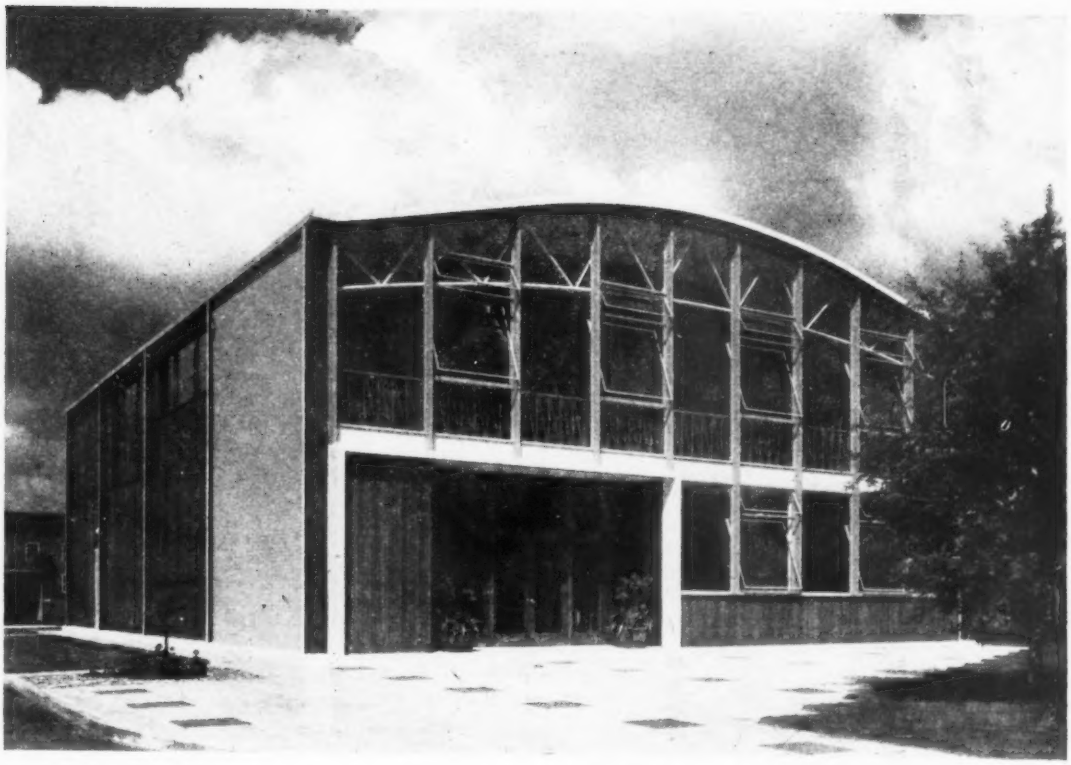
Labour working in it would be equipped with rubber boots, all dust and dirt reduced to a minimum, and the approaches to the area controlled.

Subsequently the completed work would be cleaned again, all dust removed with vacuum cleaners and the area declared a "PROCESS AREA." Once this was done and the process staff moved in to erect critical equipment, no general building operatives were allowed in again. Any further building maintenance would thereafter be done by Process Maintenance Staff suitably equipped and subject to monitoring on entering and leaving the area. Similarly maintenance work in highly active "HOT AREAS" is undertaken by "frogmen."

The precise definition of these areas and the progressive degrees of cleanliness and protection which have to be observed at each stage, ensure that no members of the construction force are able to enter radio active areas or those in which intricate plant is being erected; it also ensures that the installation of special equipment (since it is done by maintenance staff) cannot be jeopardized by labour disputes. But in addition to this the system of working to a series of declared milestones on a job imposes a sense of order in the proceedings.

Temporary building

In addition to normal site structures and labour camps there were special design problems in the building process itself. The "drill" for laying graphite has been mentioned and these temporary changing rooms and circulation areas had to be air locked and dust free (hardboard with taped joints) and with special paint finish. Service for tea breaks and meals had to be planned separately, with a hatch contact only, and all these considerations allowed for in a temporary structure planned to be erected and dismantled within



Two lecture theatres: *Top, at Harwell. Above, at Aldermaston.*

a major installation which was itself under construction.

A further example of design to a time dimension was in the siting of crane guys and anchorages so that the crane task could be completed before its guys obstructed the progress of neighbouring structures. An ingenious design for a demountable welding shed was used for assembling and welding together the "petals" which form the dome of the Calder Hall reactor vessels. (See page 529.)

Whilst in principle such problems are not new on engineering projects, it is worth noting in this case that the architects were equally involved in their solution.

MATERIALS AND TECHNIQUES

In addition to their traditional use as a means of structure and enclosure of space, building materials have been needed to fulfil new requirements of enclosure of radio activity. In each case the degree of protection necessary was laid down by the scientists and suitable materials and thicknesses agreed, but it was the responsibility of the building team to obtain an absolute consistency of quality and density.

The following points have been noted in particular:

Standardization: the possibilities of dimensional standardization were examined early in the programme and had to be abandoned owing to the individual dimensional requirements of different buildings. Certain items of equipment, such as "hot boxes" were standardized as complete units. Structural bay sizes of about 12 ft. have been used in general.

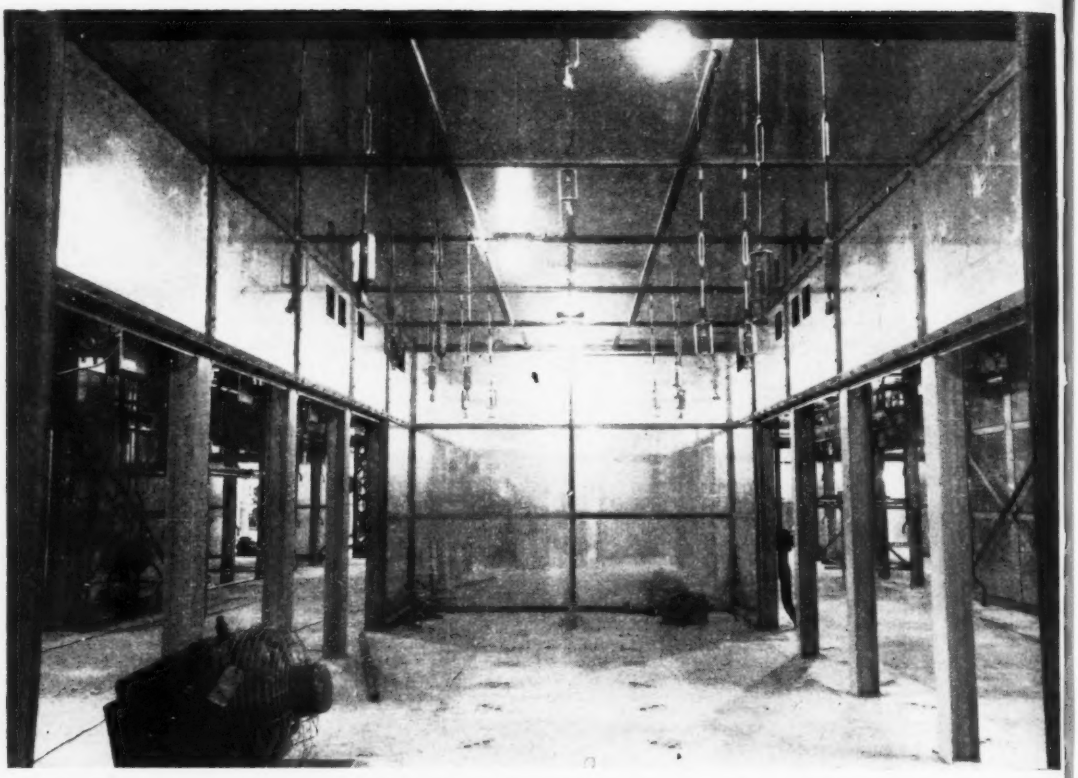
Laboratory services and connections have been standardized as well as benches which are designed as loose units connecting to them.

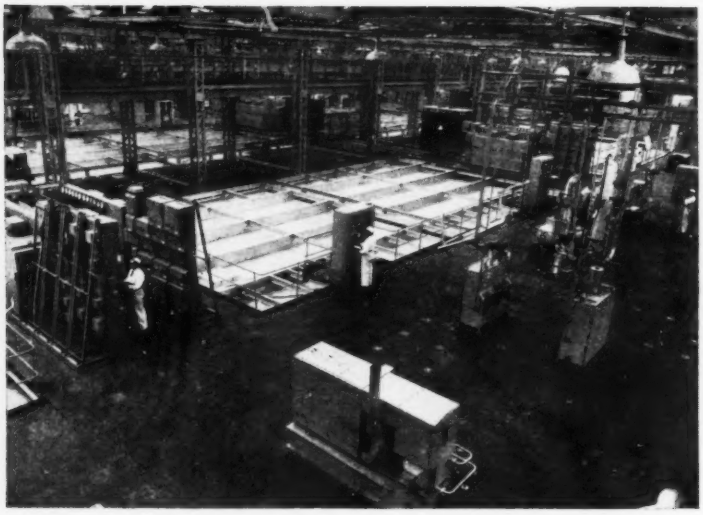
Movable units: lead and concrete blocks are used as equipment for temporary shielding in laboratory work—some of these being of crane-lift dimensions.

Demountable partition units have not been found suitable so far owing to the radiation hazard inherent in butt joints.

Staggered joints: all block work must be staggered and similarly any pipes through shield walls are bent to avoid any possibility of a through path for gamma radiation.

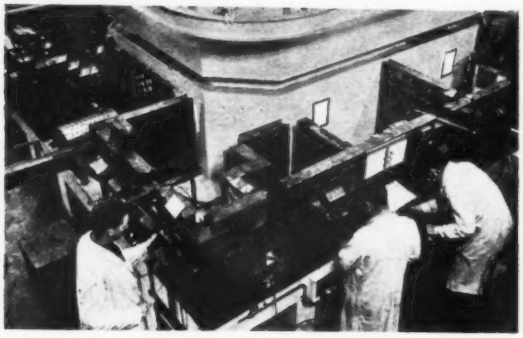
Enclosure: wall density is proportional to degree of





Gaseous diffusion plant, Capenhurst: *The gaseous diffusion plant at Capenhurst is a refinery which separates the isotopes of uranium by gaseous diffusion. This process takes place in a number of "cells" (each about the size of a house) constructed inside the main factory area. The photograph at the top shows the interior of an uncompleted cell. The photograph above left, shows the control deck above the rows of plant cells, and that above right, one of the galleries at ground floor level between the rows of cells. One feature of this construction is the high degree of accuracy (Tolerance* $\pm \frac{3}{1,000}$ *in.) required in all the parts, including the floor, which is of concrete screed. The "power float" which is now, of course, a standard piece of equipment, was originally developed to lay the acres of accurate screeding required for this floor. The wall and ceiling panels are of cork, faced both sides with aluminium and give protection against both alpha and beta particles.*

Left, working on the graphite core of one of the Harwell reactors ("Gleep") inside the thermal and biological shields. The graphite blocks are manufactured to a tolerance of $\pm \frac{3}{1{,}000}$ *in. and are laid dry. Below, left, workers in the isotope handling hall at Harwell sheltered behind barricades of rebated lead blocks.*



gamma radiation. In some cases 14 in. brick is sufficient; in Reactor shielding, 7 ft. of dense concrete. In some laboratories roofs are kept thin to allow gamma rays to escape vertically rather than rebound. Alpha and Beta particles need little thickness to stop them but they require an airtight seal and in the case of a laboratory no crevices or dust in which they can lodge.

Finishes: flush jointless surfaces are used against Alpha and Beta particles. For walls and ceilings strip lacquer paint was used at one time since it could be torn off in a sheet when contaminated; but being a nine-coat job this was expensive and it has been superseded by Vyinlite and chlorinated rubber paints which can either be cleaned or by repainting can erase the source of hazard. The inside surfaces of metal air-conditioning ducts have also to be painted. 4 mm. linoleum treated with a wax polish has been found to be the most suitable floor finish for laboratories as it can be taken up in the event of bad "spills."
On large working floors (Capenhurst floor is 24 acres) integral grano screeds were laid over a green sub-base with power floats. The Atomic programme pioneered the use of power floats in this country.

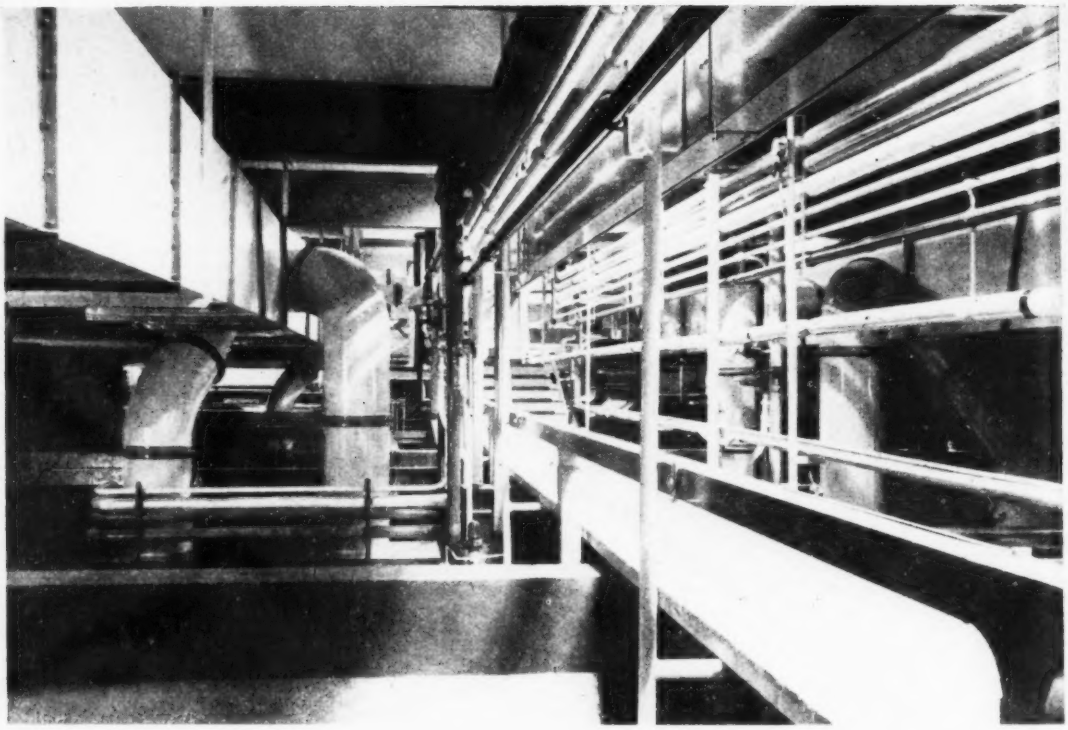
Concrete: to achieve the densities required to stop gamma rays without using unmanageable thicknesses dense aggregates have been used—Barytes, Winstone, and in some cases steel shot. Shrinkage cracks are avoided by low water/cement ratio and vibrators and steam curing methods have been used. Great accuracy of placing was called for by the fact that reactors are built from the outside inwards. Face tolerances on heights of 60 ft. could not exceed $\pm \frac{1}{2}$ in. and holing positions $\pm$ 0·03 in. The design of concrete mixes has formed a serious study throughout the programme.

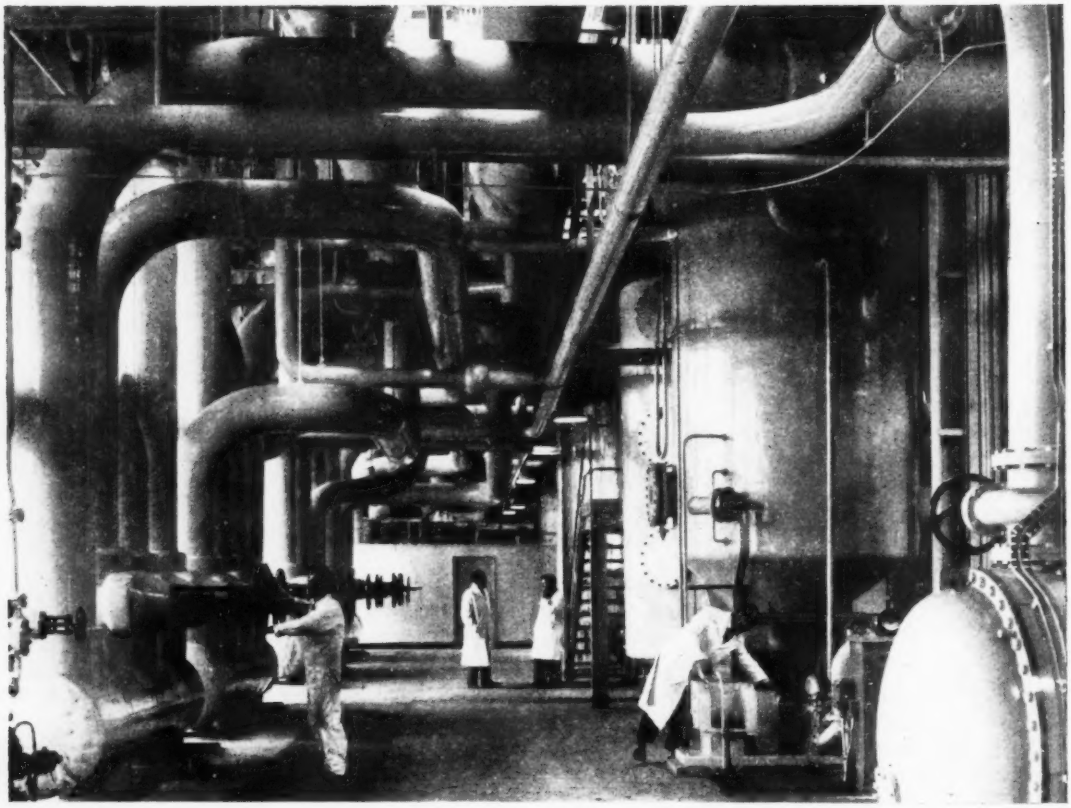
Brick has been found suitable for shielding against lower intensities, since it is essentially a staggered joint construction but precautions have to be used to get suitably dense mortar joints. Brick has also proved useful for the same reason where plant has to be completely walled up after installation.

Glazing to "hot boxes" and similar vision panels is sometimes in thick armourplate, but the tendency of glass to shatter owing to internal flaws has led to a preference for Perspex (up to $1\frac{1}{2}$ in. thick) which also has the advantage that light services and instruments can be screwed to it.

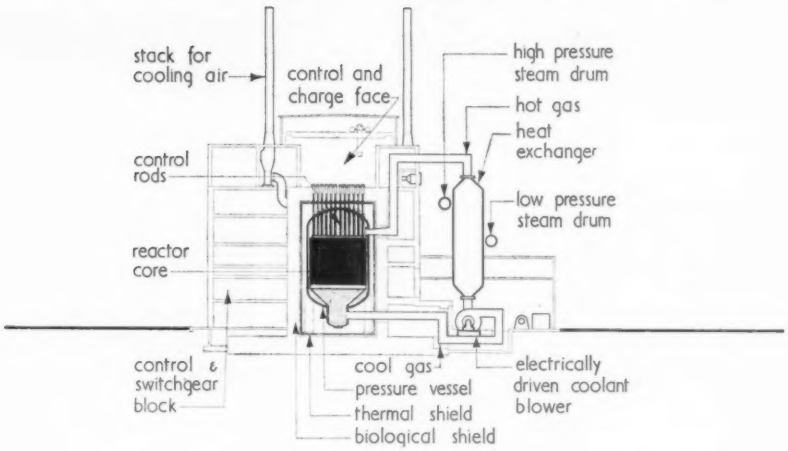
Acoustics: the requirement of smooth impervious surfaces has not been compatible with acoustic considerations. On the whole processes are comparatively silent. Where intense noise levels are concerned an absorbant lining of glass silk has been used covered on the inside by a thin washable membrane of alkathene paper fixed to P.V.C. battens.

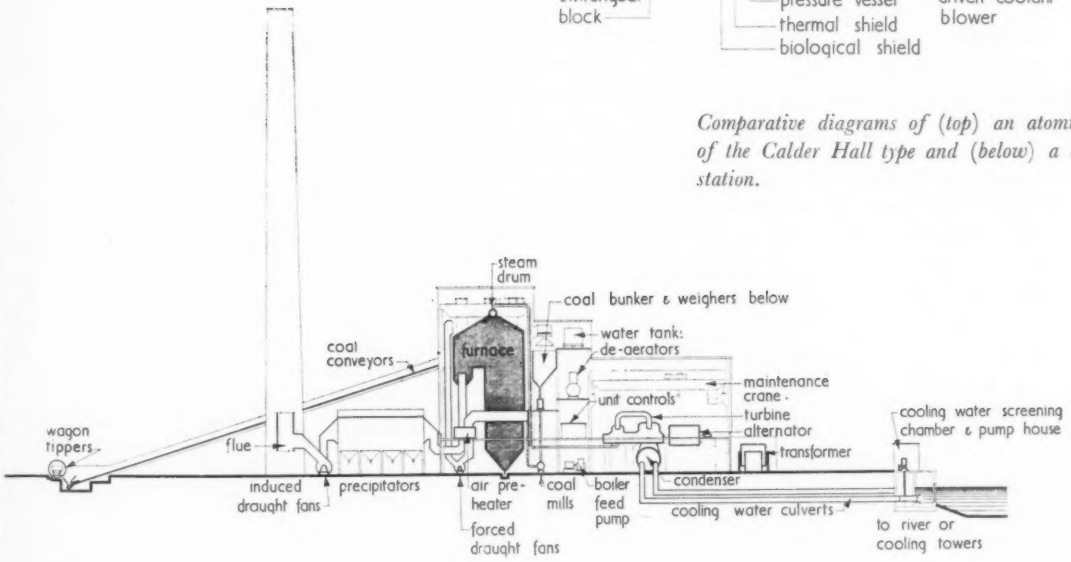
Services: the number of service runs is multiplied by their varying radio-active content. In designing service layouts every effort is made to keep the bulk of these outside radio active areas so that maintenance to pumps and valves can be done freely. Maintenance in the service corridors of hot laboratories is undertaken in many cases by "frogmen."





Accommodation of services: *The complication of the services called for by atomic research has promoted laboratory services from the traditional " ducts in the floor " to a well-lighted gallery with proper walkway. As can be seen in the top photograph, which is of the Radioactive Chemical Laboratory, Teddington. Above, is a general view of the basement of the turbine hall of the first Calder Hall atomic power station.*





Comparative diagrams of (top) an atomic power station of the Calder Hall type and (below) a coal fired power station.

Waste service pipes on atomic sites are either above ground or in service trenches which are themselves lined and drained to settling tanks. These tanks receive all waste which is then tested and if necessary treated before being allowed to pass out of the site. Tankage has to be large to allow for a bad "spill" involving a shut down on waste leaving the site.

Stainless steel pipes are used for some processes; in others polythene—the advantage of this material being that it has integral junctions and flanges. Similarly P.V.C. is found to have extensive use for ventilation ducting and many other purposes since it requires no paint finish and is easily jointed.

*Monitoring:** a description of the various systems is to be found in *Britain's Atomic Factories*. In terms of layout the tendency has been towards local monitoring for separate building groups rather than treating the whole of a large site as a Process Area. A particular construction problem was involved in the design of "Counting Rooms," where the monitor readings are automatically recorded, since the whole surface of the room had to be lined with an unbroken steel mesh (which is earthed) to avoid interference.

* See glossary on page 534.

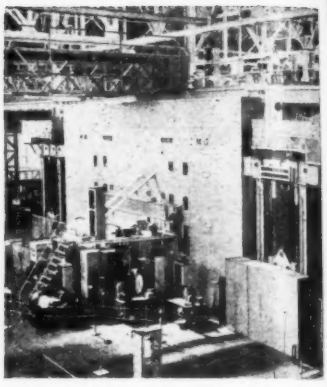
THE CONVERSION OF ATOMIC ENERGY

In converting nuclear power into electricity, nuclear scientists and engineers are faced with a problem as fundamental as that of translating the vertical pump stroke of the steam-engine into rotative motion. James Watt solved this, in the first instance, by steam-pumping water to a height and allowing it to fall over a water wheel. The early solutions in harnessing atomic energy are likely to be seen later as being as clumsy. Atomic structure is built up of electrically charged and moving particles which have an energy content, but at present there is no known practical* way of converting this energy to electrical power without the intermediary of a heat cycle.

In simplest terms, therefore, the primary function of a nuclear reactor is to generate heat. This heat is transferred to coolants, which in turn boil ordinary light water in steam-raising towers. Generally a double-pressure steam cycle is developed to propel turbo-alternators of conventional design.

When natural uranium is used as the fuel element, it is necessary to slow down the neutrons by using a "moderator." This is necessary because natural uranium contains only one part in one hundred and

* The Americans have produced a fission battery producing 10 (amp.



Right, the Graphite Low Energy Experimental Pile ("GLEEP") and extreme right, the British Experimental Pile ("BEPO"), both at Harwell.

forty of the fissile isotope U-235. If neutrons were emitted at high speeds, they would be completely absorbed by the non-fissionable isotope, U-238, and chain reaction would be impossible. A relatively large quantity of uranium is required to form a lattice laid in channels in the moderator, and the size of reactor is accordingly large. In an ascending scale of enrichment of the uranium charge the core size diminishes, but the "specific rating" i.e. the ability to transfer heat from the core, increases beyond the limits of present metallurgical techniques. The material used as moderator is usually graphite, and heat transfer is by a coolant gas. A reactor using natural uranium is called a "thermal reactor."

The main atomic structures

Prior to the completion of the first Calder Hall Atomic Pile, four nuclear reactors had been completed in Great Britain. The first two of these, the small Graphite Low Energy Experimental Pile ("GLEEP") and the somewhat larger British Experimental Pile ("BEPO") were at Harwell and, being comparatively small in scale, were contained within the conventional factory structures (see photographs above). The second two were built at Windscale and are best known by their gigantic ventilation shafts.

The "British Experimental Pile," BEPO, at Harwell was completed in 1948. It is a thermal reactor using graphite as moderator and pure air for cooling. The core, a 26 ft. cube built up of graphite blocks, rests on a concrete plinth, and is surrounded by a thermal shield and concrete biological shield. There are 1,760 horizontal channels in the core—approximately half of these are loaded with uranium, forming a cylindrical reacting core 20 ft. in diameter. The thermal shield of 6 in. steel plate protects the inner face of concrete from overheating due to neutron absorption, and the biological shield, which is 6 ft. 6 in. thick, reduces gamma radiation to a safe level.

The pile is charged and discharged through tubes cast in the concrete opposite each channel in the graphite. Hydraulic hoist platforms enable any channel to be reached. Control of the pile is effected by four 2 in. diameter steel tubes, filled with boron. Boron acts as neutron-absorber, and slows down the process to any desired level. The control rods are inserted horizontally at right angles to the uranium channels, and can maintain a fixed power level by automatic control. Ten similar rods, "shut-off" or safety rods, inserted vertically, cause a shut-down of all reactivity.

Cooling air, which is sucked into the core and discharged through a filtered chimney, gains a temperature of around 90 deg. C., and is used to operate a water heater of 2,000 kw. output.

Windscale

The Windscale Piles are probably the largest air-cooled piles in the world. The discharge stacks, which are 44 ft. in diameter, rise over 400 ft. vertically, and a total loading, for each pile, of 58,000 tons is carried on a foundation raft 21,000 sq. ft. in area. The design principles are similar to those of BEPO. The graphite core is contained within a concrete envelope. Control rods are inserted horizontally, shut-off rods vertically. The process is industrial as opposed to BEPO, which is primarily experimental. Natural uranium is irradiated and a small proportion of the non-fissionable isotope U 238 is converted plutonium. Plutonium is extracted in the Chemical Separation Plant* at Windscale, and used for the armaments programme. Irradiated cartridges are ejected from channels in the moderator to fall into a hopper truck. This truck is carried by an underwater railway in a duct which passes below the pile, through the main shield to an outside storage pond. Here the cartridges are cooled and de-canned. One ton of irradiated uranium is likely to contain about a pound of plutonium.

The filters are radio active and, when saturated, they are changed by remote control and lowered to the ground in a lead coffin. A 7½ ton hoist is attached to the stack by slip fastenings.

Calder Hall

The Calder Hall Piles are a more advanced form of the gas-cooled, graphite-moderated system. They are the first reactors designed specifically for power production, and as such are prototypes. The need for inherent safety has probably resulted in a degree of over-precaution. The completed station will have four piles, each pair with a turbine block between them, and administration buildings.

The core is enclosed in a steel pressure vessel 70 ft. high and 37 ft. in diameter.† Graphite blocks form a cylinder of approximately 30 ft. diameter, and the fuel elements are placed in vertical channels. Control and shut-off rods are also inserted

* See Glossary.

† See comparative diagrams of coal-fired power station and nuclear power station on page 523.

vertically. Heat transfer is by carbon dioxide gas, which circulates through four heat exchangers placed outside the biological shield.

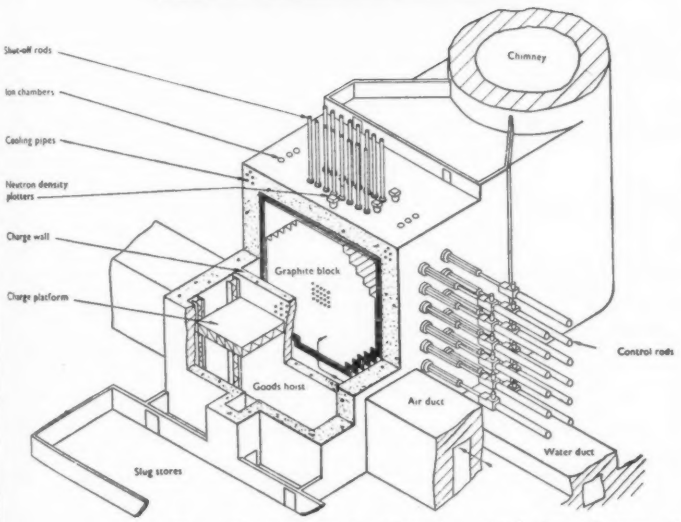
An octagonal concrete envelope, some seven or eight feet thick, forms the biological shield. Alternative sections were poured first and allowed to set, before the intermediate sections were cast. An octagon was chosen in preference to a circle because of the danger of shrinkage cracks. There is a 6 in. air gap between the steel thermal shield and the inner face of concrete, and air is pumped continuously through this gap for cooling purposes. Twin stacks discharge the hot air. Mechanical apparatus is housed on top of the reactor, the control room is at the side.

The turbine block has a total installed capacity of 92 Mw. Between 60 and 65 megawatts will be transmitted to the national grid, the balance will be used to drive large circulating fans in the blower houses, and also some equipment at Windscale.

The United Kingdom Atomic Energy Authority is at present building a prototype "Fast Reactor" at Dounreay in Scotland. The "Fast Reactor" represents the ultimate stage in diminishing core size, where a 2 ft. cylinder, 2 ft. high is used. The core will have a heat rating in the region of one hundred times greater than that of Calder Hall. Plutonium, the valuable by-product of thermal reactors, can be used in artificial blend with a non-fissionable isotope as fuel element. In this way a positive gain factor should result with more fuel being produced than "burnt."

A liquid metal coolant will have to be used due to the very high temperature of the matrix. Circulation of the coolant will be by electromagnetic pumps which have no moving parts. If a breakdown should occur, the intense heat might cause a fire, and this in turn the release of active fission products. At Dounreay an air-tight steel sphere, 135 ft. in diameter, will prevent the escape of radio-activity should a breakdown occur.

Generally the possibility of accident in a nuclear power station is no greater than in the conventional power plant, but its results would be more widespread in contaminating the surrounding area.



Top, the Windscale plutonium producing factory at Sellafield. Above, diagrammatic section through the Windscale reactor. Below, the Dounreay reactor.

EPILOGUE

The main achievements of the initial building programme for atomic energy have been the solution of new and complex technological problems with success and with speed. On those grounds alone the building effort has been a triumph.

From the point of view of design as such the issue has been less clear and the total result less consistent. There are good reasons for this. The programme on many of the sites started from an attempt to re-use existing ordnance and airfield buildings, and because the extent of development was not known, the first extensions were built in similar vein. Thus in the worst instance Springfields has never managed to rise from the mediocrities of the wartime gas factory from which it has been adapted.

But in addition to the restrictive influence of old buildings, the programme as a whole has been subject to all the vicissitudes of the last ten years of building both as regards shortages of materials and the changes in attitude to building technique. In the simpler buildings one can see, as in a history sheet, successive examples ranging from Neo-Georgian RAF station buildings converted for use as laboratories, to a more direct approach in the latest laboratory buildings and from MOW huts to those very forms of construction developed on schools to avoid the use of MOW huts; there are examples of the influence of the 1951 Festival and even of Scandinavian Empiricism.

The criticism where it applies is not of the architects of this programme but of the confusion of architectural thought during the period. For it was on this general vernacular that the architects of this programme, preoccupied as they were with new technical

problems, had to draw for solutions to comparatively simple buildings and details. Expediency allowed of no other course.

A national programme of the calibre of the atom must of necessity be under a spotlight as regards every detail of design as well as its other implications, for it stands for the industrial future. Therefore, whatever the expediency involved in the experimental phase, a survey of the results, which are many, seems to suggest a number of points affecting industrial architecture as a whole.

Firstly, that pre-occupation with what installations and buildings should look like is secondary to the task of making them what they really are. Therefore the Windscale and Calder buildings in particular succeed by virtue of monumental fact in contrast, for instance, to many Power Station buildings constructed during the same period in other parts of the country. This also applies to the plant buildings; chimneys, pipe supports and other ancillaries. These plant elements are the most interesting forms and deserve to take pride of place in every sense, including colour. Compared with them the secondary buildings such as offices and welfare buildings succeed best when they are at their simplest, as in the later stages of this programme; where they are elaborated in any degree they cannot fail to seem self-conscious.

Compared with the importance of the function of plant the question of architectural detail is, on the face of it, a humble issue. But it is precisely in the sum of these humble details that there lies the margin between industrial architecture and industrial building.

We have the examples of the London Underground programme between the wars and the development of school design since the last war as evidence of an approach which has put us into the world class and there are promising signs in some fields of housing and hospital design. The successful examples result from a demand for good design from the top, and point to a key rôle which transcends any day to day pre-occupations of engineer or architect; it is the rôle of the impressario—such as Frank Pick filled for the London Underground and Diaghileff for the ballet.

Industrial installations have ceased to be the exception in the national landscape; they are fast becoming the rule and, as such, have a duty to succeed not only as process but also as environment. It is only by refinement of every detail towards a sense of the whole that industrial building may achieve those qualities akin to sculpture on which it will be judged by men of the technological future.

Circumstances have not allowed the Atomic programme, in the experimental phase, to achieve a consistent quality of design, nor could it have been expected to do so.

As the controlling body behind the key industry of the future, the Atomic Energy Authority now carries the onus of backing a design policy of a calibre to match its technological achievements.

Notes on Calder Hall Reactor

Since the Calder Hall Reactor (or, to be exact, the first of them) is the most recent atomic building of importance to be completed, we conclude this special article with a note on it which has been prepared by T. L. Viney, F.R.I.B.A., and R. S. Brocklesby, A.R.I.B.A., who are, respectively, Deputy Director, Works and Construction and Chief Architect of the United Kingdom Atomic Energy Authority Industrial Group. This note describes the main purposes the fabric of the reactor had to fulfil and some of the more unusual constructional methods which had to be used to build it. As these are typical of the problems inherent in building for atomic energy they serve to illustrate many of the points made in the main section of the issue.

Electricity is produced at Calder Hall by atomic energy in a graphite moderated reactor (represented by a solid black rectangle in the section) which constitutes the heat source. Heat is transferred from the reactor to four heat exchangers or calorifiers (14 in diagrams opposite) by carbon dioxide gas; this gas is pumped through the reactor by electrically operated fans. The heat exchangers are fed with water which is converted to steam and piped across to the turbines in the conventional manner.

Heat transfer from the reactor to the turbines therefore is by way of a primary CO_2 circuit and a secondary steam circuit. The reactor and heat exchangers take the place of boilers in a coal fired station.

The reactor is contained within a steel pressure vessel (1) and is constructed with cored graphite blocks

which are in horizontal layers and form vertical coolant channels. The uranium fuel is lowered into the channels from above through charging tubes (5).

During operation the reactor emits rays through the pressure vessel and to a much lesser degree through the primary circuit; these rays require to be shielded so that persons operating the plant are properly protected.

The method of shielding is a steel plate to slow down neutrons (3), together with a reinforced concrete barrier to contend with gamma radiation (2). Between the steel plate " thermal " shield and the concrete shield is an air space through which cooling air is induced by a fan under pressure (see the cut-away axonometric drawing, page 528). This is necessary to maintain the face temperature of the concrete at a level which will prevent disintegration.

Operation of the reactor involves the mechanical charging and discharging of uranium fuel elements and an elaborate system of instrumentation to record what is taking place within the pressure vessel and elsewhere.

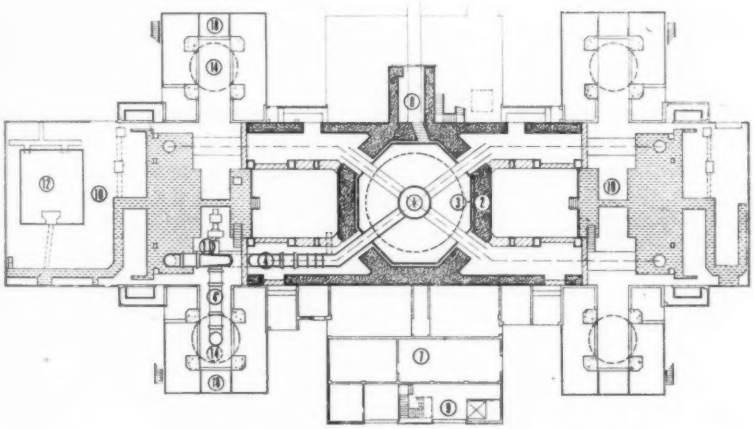
Design for the Reactor Structure

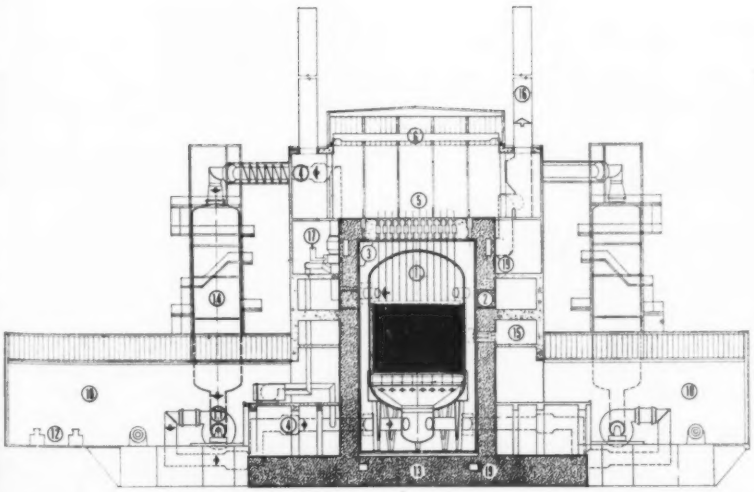
The design of the reactor building starts from the steel pressure vessel (1) containing the reactor; it is 37 ft. diameter and 70 ft. high and stands on steel supports which transmit the load to the base.

The pressure vessel is housed within a concrete biological shield (2), with sides and roof 7 ft. in thickness, inner faces being lined with a 6 in. thick steel thermal shield (3). Both shields are octagonal in plan, this shape being more economical than the circular form. Pipes for CO_2 circulation (4) and numerous tubes for charging and control of the reactor penetrate the shielding and it is necessary to provide secondary protection of these points.

The concrete shielding needs to have a density of 150 lb. per cubic foot and must be free from cracks and air pockets. This necessitated careful positioning of construction joints and a high standard of supervision of the placing of the concrete. The density is important since this is directly related to the thickness required for proper protection.

The steel heat exchangers, 17 ft. 6 in. diameter and 77 ft. high, are disposed symmetrically round the outside of the building and stand on reinforced concrete tables. The steel CO_2 primary circulation pipes, 4 ft. 6 in. diameter, connect the pressure vessel to the heat exchangers through the shielding and are shielded themselves with concrete. A well-lighted working space houses the charging and discharging mechanism on top of the reactor (5). This is traversed by cranage (6).

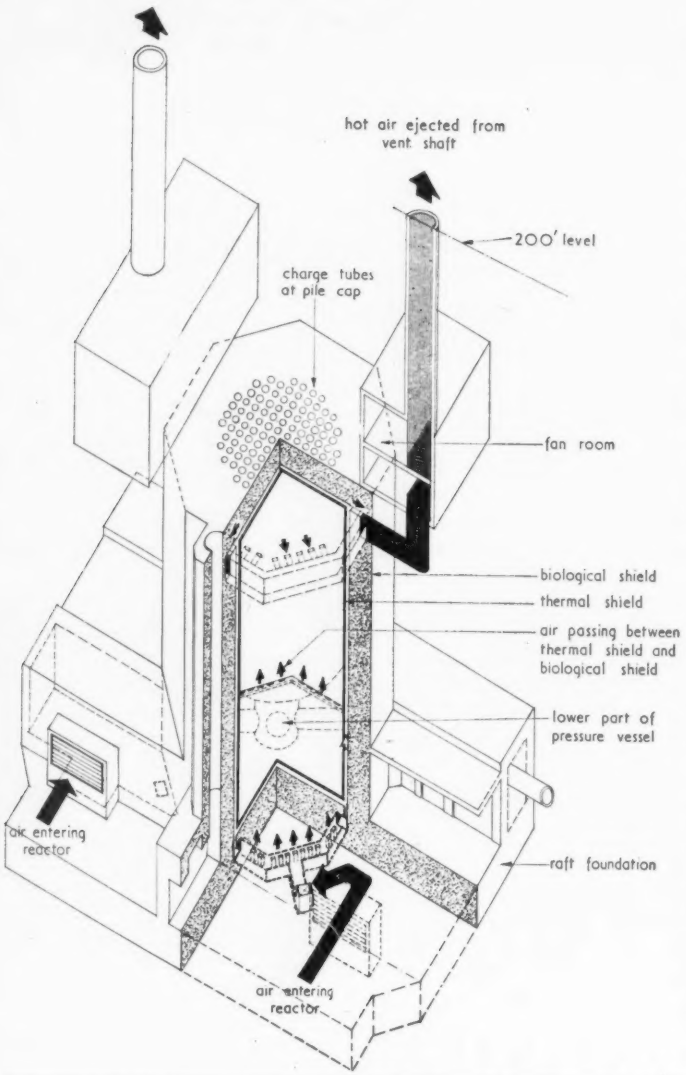




Above left, plan, and below left, section of Calder Hall Reactor [Scale: $\frac{1}{64}$" = 1' 0"]

KEY:

1. Steel pressure vessel.
2. Concrete biological shield.
3. Thermal shield.
4. CO_2 pipes.
5. Charge and discharge face.
6. Crane.
7. Control side.
8. Discharge side.
9. Staircase and lift.
10. Fan house.
11. CO_2 fan.
12. Diesel stand-by generator.
13. R.C. raft.
14. Heat exchanger.
15. Ion chamber.
16. Ventilating shaft.
17. Gate valve.
18. Water circulatory pump house.
19. Air cooling ducts.



Left, axonometric cutaway diagram, showing the circulation of cool air. Air circulates from low to high level through the space between the thermal and biological shields.

On two sides of the reactor a steel framed, asbestos clad, structure is arranged with floors at various levels to accommodate the electrical, instrumentation, control and staff requirements, also staircases and lift.

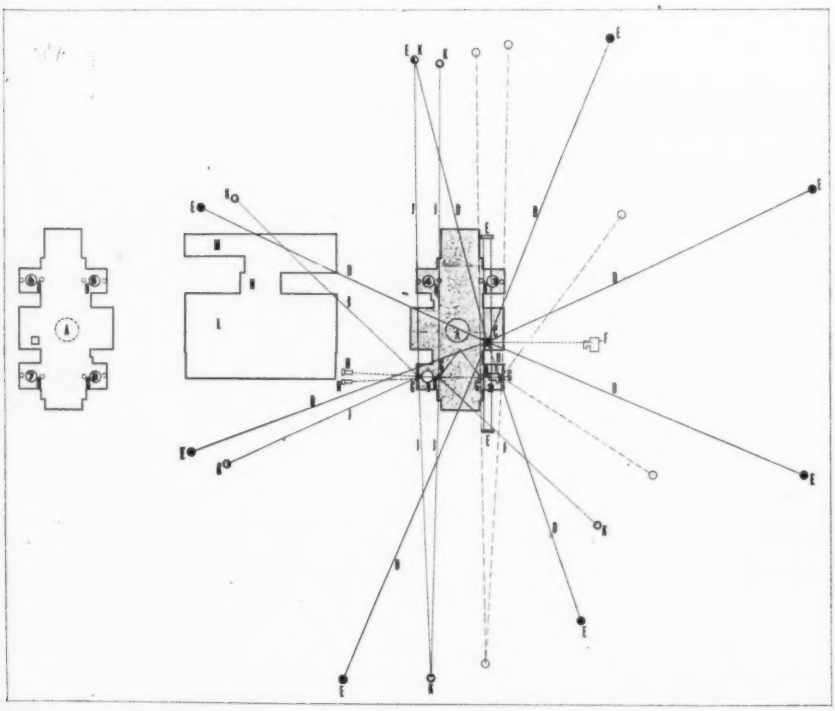
The electric fan houses (10) are disposed on opposite sides and are steel-framed asbestos cladded buildings traversed by overhead cranes. The fans for CO_2 circulation (11) are housed in these buildings, together with diesel stand-by generators (12).

The heavy central load of the reactor and octagonal shield is distributed over a reinforced concrete raft 11 ft. thick (13) and concrete shielding to CO_2 pipes serves also as buttresses to assist in spreading the foundation load. The heat exchangers (14) stand on their own foundation adjacent to the corners of the main raft.

Site Layout and Construction Facilities

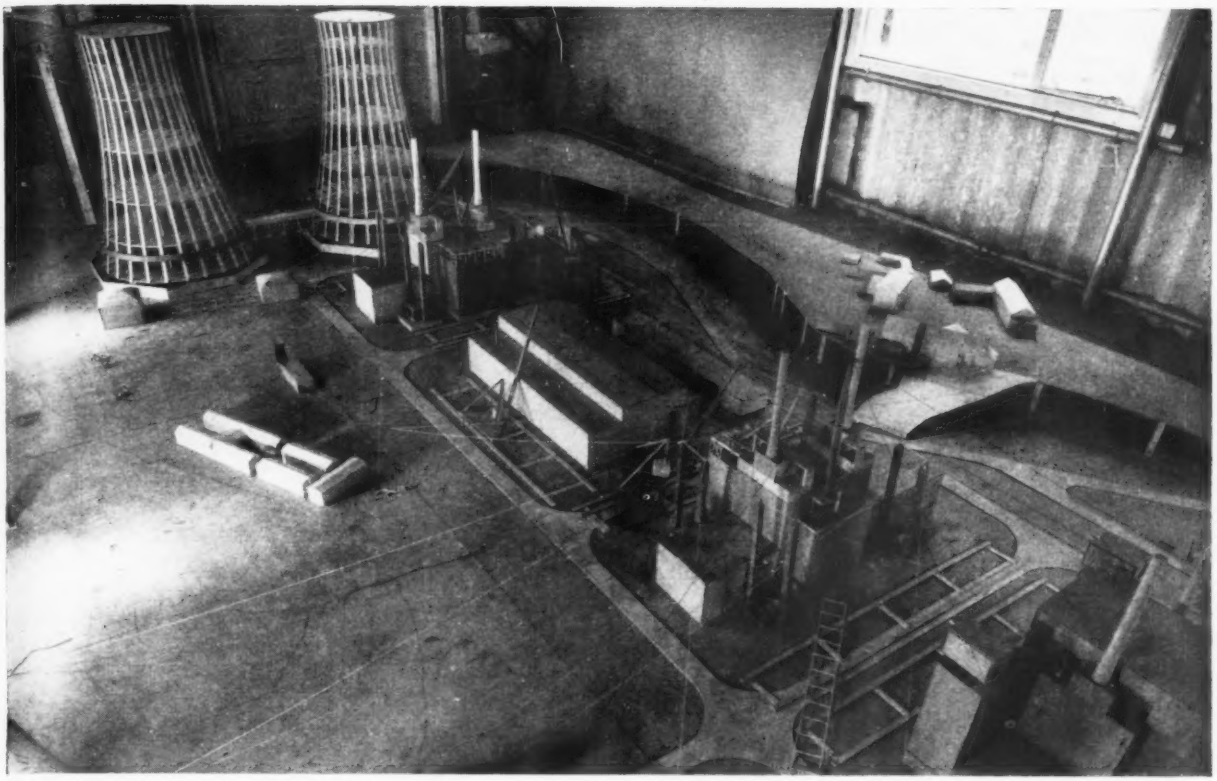
In considering the layout for the power station the problem of lifting the abnormally heavy loads of the reactor pressure vessels had to be taken into account. Construction of the turbine hall had to proceed along with the reactor, also the cooling water ducts and cooling towers.

For these reasons it was decided to plan the reactors and turbine hall as separate buildings so that all round access could be maintained for the reactor buildings during construction. In effect it was found that the handling of the heavier components on the site was in many respects a decisive factor in the design itself. On this page we show a diagram illustrating the hoisting arrangements for placing the reactor pressure vessel and one of the heat exchangers; and opposite

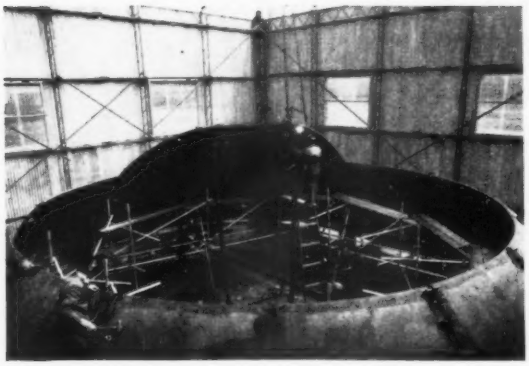


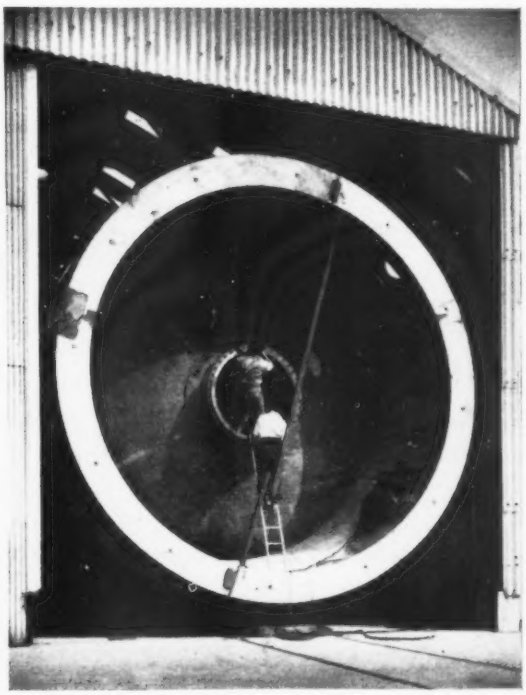
KEY:
A. Reactor pressure vessel.
B. Heat exchangers.
C. King post derrick.
D. Steel hawsers to king post.
E. Concrete anchor blocks for king post derrick.
F. Pressure vessel winch.
G. Latticed steel shear legs.
H. Heat exchanger winch.
J. Steel hawsers to heat exchanger shear legs.
K. Concrete anchor block for shear legs.
L. Turbine hall.
M. Administration.
N. Control.

Left, diagram showing the site layout scheme for mounting the reactor pressure vessel and one heat exchanger. Note: the dotted lines represent the hawser positions for mounting a second heat exchanger. (Scale: $\frac{1}{256}$ in. = 1 ft.)

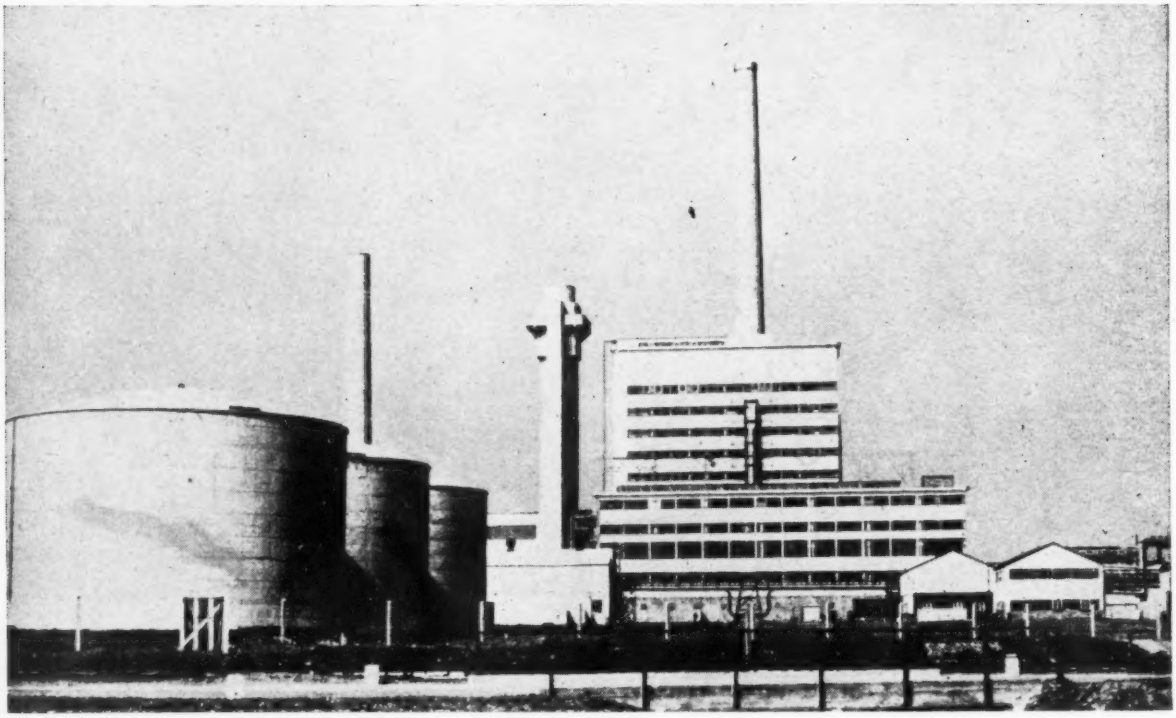


Above, part of the site layout model used for planning the lifting operations. The reactor next to the cooling tower is the one now completed. The square domed blocks to the left of it are temporary sheds for the fabrication of the reactor vessel. It will be noted that the shear legs for mounting all four heat exchangers are in position on both reactors though in practice these are only mounted one at a time. Below left, welding the "petals" of the domes of heat exchangers. Bottom left, welding the "petals" of one of the domes of a reactor vessel. It will be noticed that the roof of the temporary shed has been removed. Below right, men working on the base of a heat exchanger.





★ *Britain's Atomic Factories*



Designed by the Chief Architect's Division, Ministry of Works

★ *Plutonium Plant at Windscale, Sellafield, Cumberland*

The work included:—The Plutonium Separation Group, Ancillary Buildings, Prestressed Concrete Tanks, Effluent Outfall and underwater clearance, Roads, Railways, Main Drainage and Concrete Pipe Bridges.

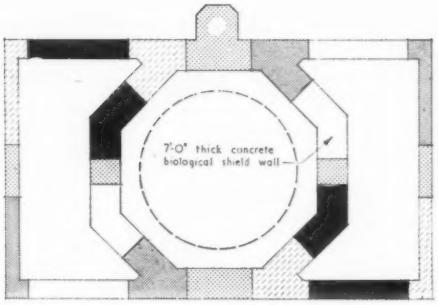
★ *Diffusion Plant at Capenhurst*

The work under construction includes two main process buildings, covering many acres; Ancillary Buildings, Roads, Railways, Main Drainage.

THE MAIN CONTRACTORS FOR THE TWO ATOMIC PLANTS AT WINDSCALE AND CAPENHURST . . .

TROLLOPE & COLLS

ESTABLISHED 1778



Above left, the concrete structure of the reactor in course of erection. The king post derrick for hoisting sections of the pressure vessel is in position at the top of the reactor. The two latticed steel posts are in position, on the left, for hoisting the heat exchanger. Left, diagram showing alternate bay construction of biological shield. Above, the second reactor building during construction. The octagonal steel framework for supporting the timber shuttering is shown in the centre.

we show a photograph of a scale model of the site which was prepared to show whether the lifting proposals were feasible. As can be seen from this model (which shows the hoisting arrangements for the first two reactors), the cladding was omitted from the top storey of the enclosed part of the structure until after the hoisting was over: the reason for this being that some of the steel hawsers supporting the shear legs passed *through* the top-storey structure. In one case a steel hawser had a clearance of only four inches, after due allowance had been made for whip.

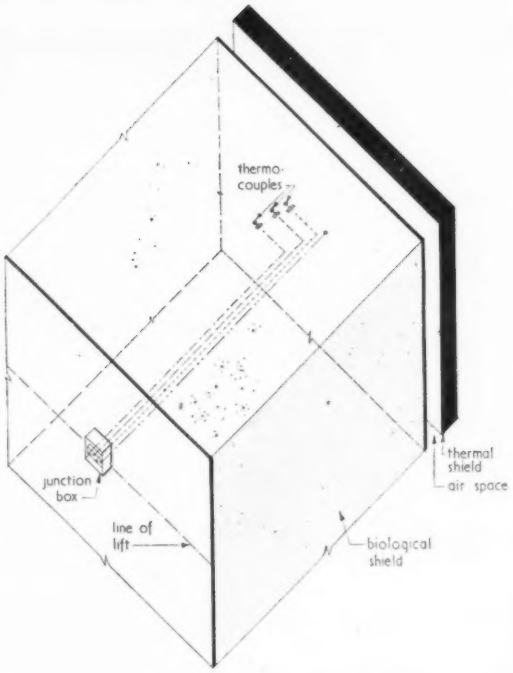
Facilities had to be provided on site close to the reactors for fabrication of the pressure vessel. This, for constructional purposes, was divided into a series of units each weighing 120 tons comprising the top and bottom domes and a number of intermediate rings. Each of these units were assembled and welded on the site in temporary sheds, two of which can be seen in the top left-hand corner of the photograph of the site layout model. It is interesting to note that the roofs of these sheds were designed to lift off in one piece so that the completed unit within could be lifted out, placed on a low-loader and transported to the foot of the reactor building ready for lifting in position. The completed top dome of the first reactor waiting to be lifted out of its assembly shed can be seen on page 529.

The heat exchangers were brought on to site in rings and welded together; the completed vessels weighing 200 tons were then likewise transported by low-loaders from the site workshop and lifted into position on their concrete tables.

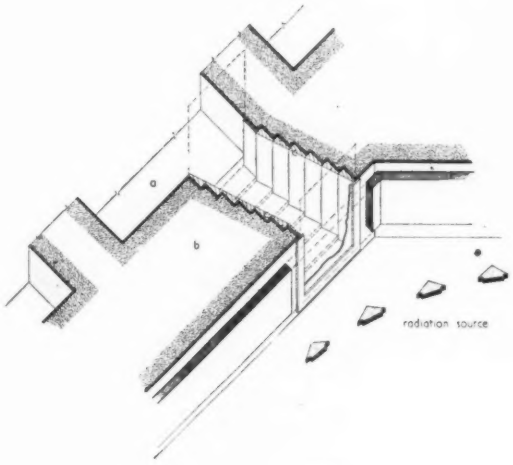
Construction of reactor building, pressure vessels and turbine hall proceeded at the same time.

The concrete octagon with its steel thermal shield was erected as far as the underside of the lid, 80 ft. high, at which stage the first lift of the pressure vessel legs and bottom dome took place; to lift these heavy components up and lower them down into the base of the octagon a king post derrick crane was used (see photograph above).

The king post derrick was placed at the side of the octagon on the foundation raft and erected on a steel-framed tower 90 ft. high. The king post was hoisted up through the centre of the tower and supported



Above, diagram showing thermocouples placed in 7 ft. thick biological shield to keep check on heat absorbed by the main face. Below, temporary access hole from the discharge chamber (a), through biological shield (b), showing method of staggering joints to avoid a through passage to radiation when the hole is finally walled up.



during and after erection by a number of steel hawsers in the form of a spider. The top of the derrick was 180 ft. above ground and the hawsers were arranged in a circle, each having a concrete anchor block entirely below surface level. Powerful winches on the ground controlled the crane.

Temporary lifting facilities for raising the heat exchangers into position consisted of two latticed steel posts 120 ft. high, each guyed with a spider of steel hawsers 200 ft. in diameter and ground winches. Heat exchangers were erected in sequence and lifting facilities had to be re-erected for each one ; some of the concrete anchor blocks were sited for re-use on two or three occasions.

For the construction of the reactor buildings derrick cranes on 40 ft. gabberts were run on tracks on two sides, one of these being 15-ton capacity for raising the CO_2 pipes and valves.

The 7 ft. thick concrete shield was laid in eighteen lifts in alternate bays to minimize shrinkage (see page 530). The concrete was vibrated and the joints were keyed to serve the double purpose of bonding the concrete and preventing the free passage of stray neutrons from the reactor. A nominal amount of reinforcement meshed throughout the concrete withholds the shield against any expansion set up on the inner face by the great heat. So that a check may be kept on the temperature of the inner face, thermocouples were laid between lifts at different distances from the face (top diagram). Shuttering was in timber supported by a steel lattice framework set up within the shield. This framework may be seen in the photograph on page 530.

In order to give easy access to the inside of the biological shield during the assembly of the thermal shield and the pressure vessel a temporary access hole was left in the base. This was formed at an oblique angle through the 7 ft. shield with staggered joints (bottom diagram). The arrises of these were protected with timber during the progress of the work and the hole was filled up with concrete blocks laid dry on completion.

The thermal shield consists of a number of mild steel plates 6 in. thick, 8 ft. wide and 3 ft. high. These were lowered singly into position and were secured to the biological shield by brackets projecting 6 in. from the wall face (see page 532). Aluminium cover strips were used to ensure that no air is sucked out of the reactor vessel through the joints in the thermal shield.

A problem was the gate valve to the CO_2 extract duct numbered (17) on page 527. As this is liable to failure it had to be removable; but the chamber in which it is placed is radio-active. Since this chamber lies directly under the floor of the working space surrounding the pile cap, access was provided through this floor in the form of 12½-in. thick precast concrete covers beneath 2½-in. granolithic flooring. When access is needed the granolithic must be hacked up (see page 532). Another element in the design which penetrates the two shields is the group of liner tubes passing to the ion chamber. The ion chamber which is numbered (15) on the key section (though the chamber itself is on the *inside* of the shields, not on the outside) is a control which enables observers to tell the amount of ionizing undergone by the uranium charge and the main reactor vessel. It takes the form of a cavity inside a graphite block bracketed to the inner side of the thermal shield. A small amount of uranium is passed through liner tubes into this cavity and instruments show the amount of ionizing this uranium receives. The positioning of the liner tubes relative to one another and to the pressure vessel was highly critical and care had to be taken to ensure that when they were cast in, the vibrating of the concrete did not move them. To prevent this, they were built into a cage of mild steel angles and flats and the whole was cast in.

Shuttering for the concrete lid shield over the reactor

Littlewoods New Store at Dumbarton.
Designed by: Littlewoods Construction Dept.
Engineers: Bingham & Blades & Partners, Liverpool.
Contractors: A. A. Stuart & Sons Ltd., Carmyle, Glasgow.

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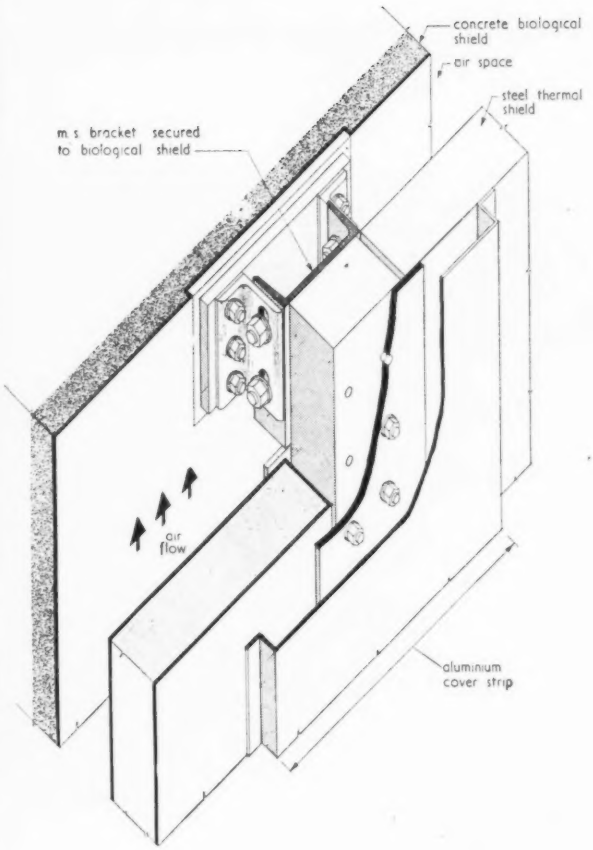
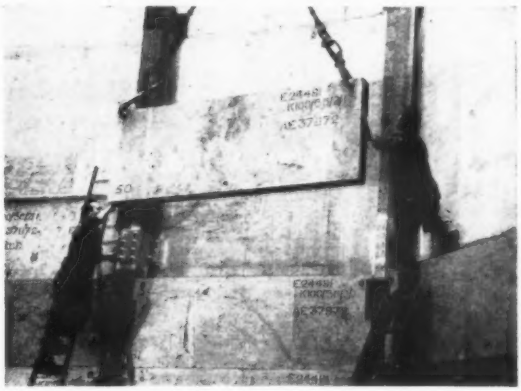
CON 76

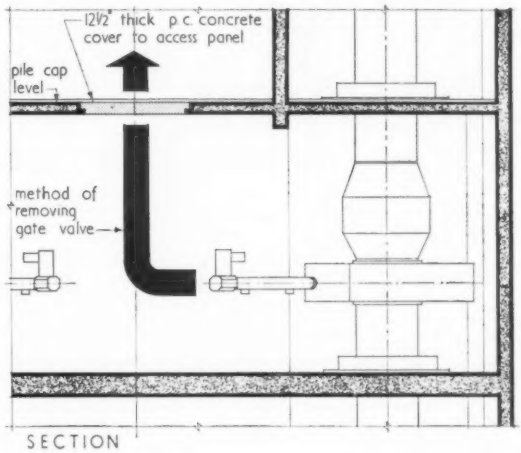


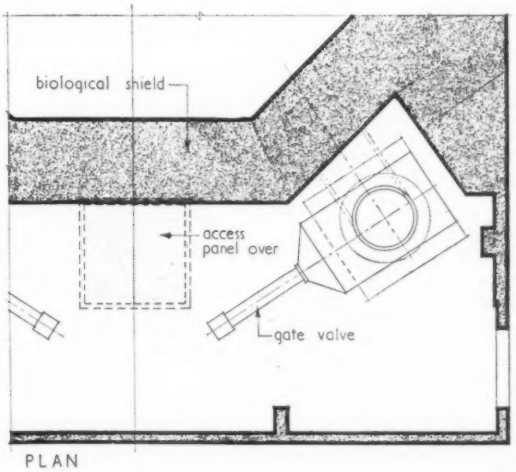


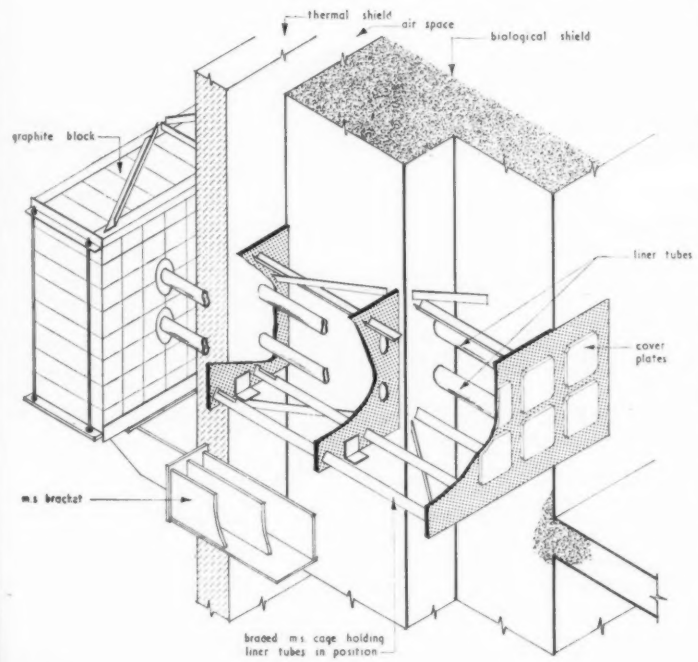
Left, detail of fixing thermal shield (6-in. m.s. plates) to biological shield (7-ft. concrete). Above, fixing one of the 6-in. thick plates on the thermal shield.

was suspended by a number of 1½-in. diameter hanger rods slung from Bailey Bridge units (see page 533). When the concrete was of sufficient thickness to support its own weight the bridges were removed and the concreting completed. Concreting of this lid was the most complicated placing encountered because of the numerous charging tubes; reinforcement had to be fixed, concrete placed and vibrated though only sufficient space was left between tubes for a man to squeeze by. The sequence of operations is further described in the caption to the diagrams on page 533.

Right, detail showing arrangement for removing the vulnerable part of a defective gate valve in a CO_2 extract duct. Below, detail showing the steel "cage" used to hold in alignment tubes passing through the shields to the ion chamber (contained in the graphite block on the left).







Insulation at Capenhurst

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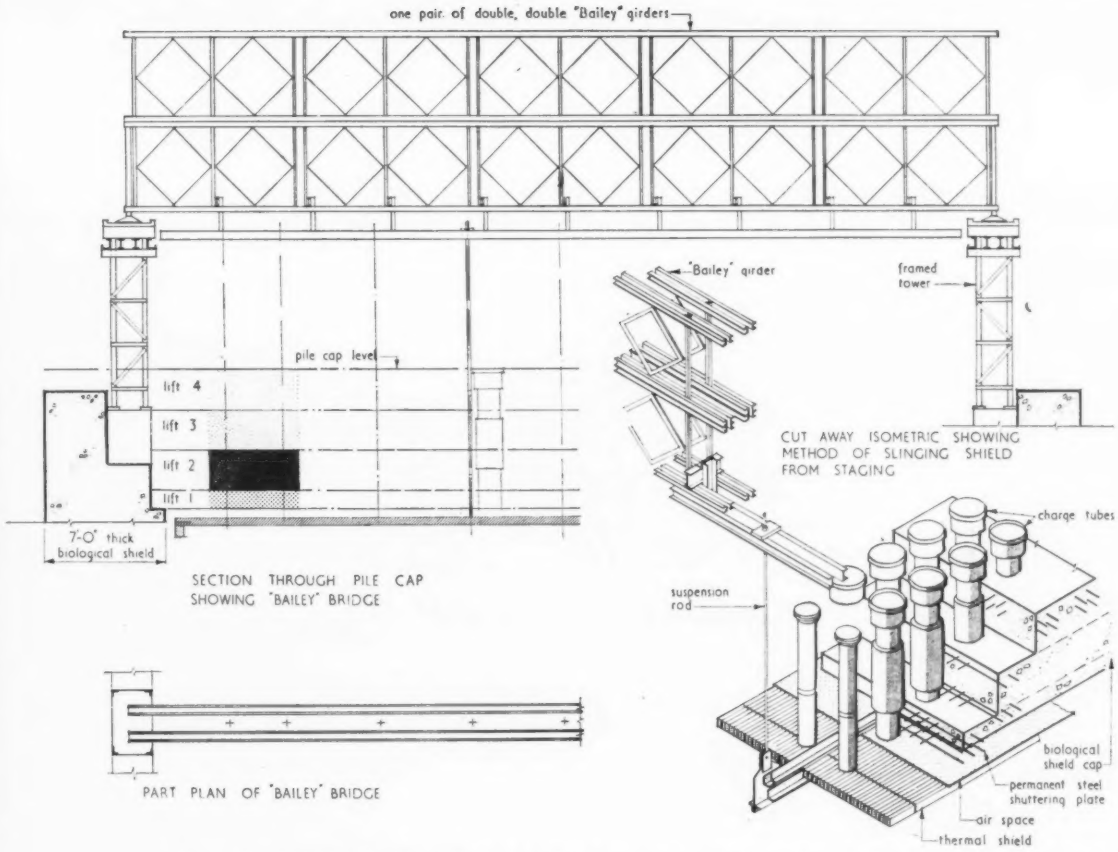
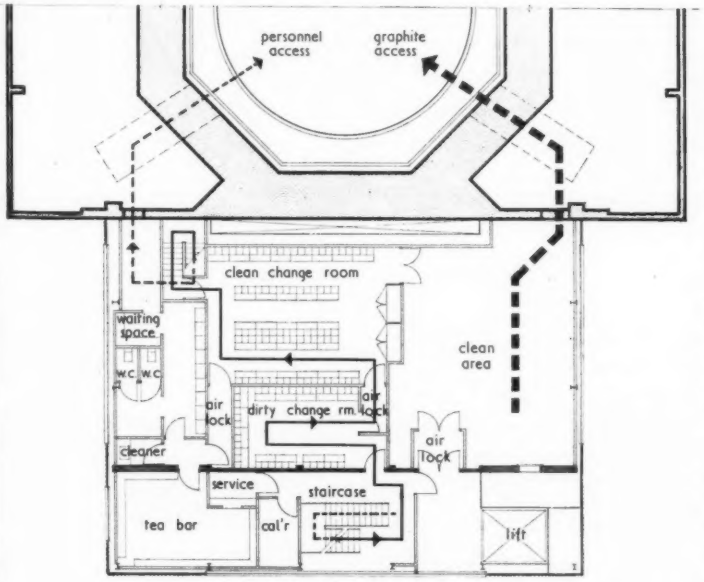


Above, diagrams showing the method of casting the concrete lid over the pressure vessel. Five pairs of double Bailey girders carried $\frac{5}{8}$-in. m.s. permanent shuttering plates on $1\frac{1}{2}$-in. diameter suspension rods. The roof was concreted in four lifts, adjustment being made to the rods after each lift to compensate for deflection in the concrete. Charge tubes and equipment pierced the concrete slab (and the thermal shield) in a chequer board pattern and reinforcement was placed between. The hangers were cut off after the third lift and the framed towers and girders were removed.

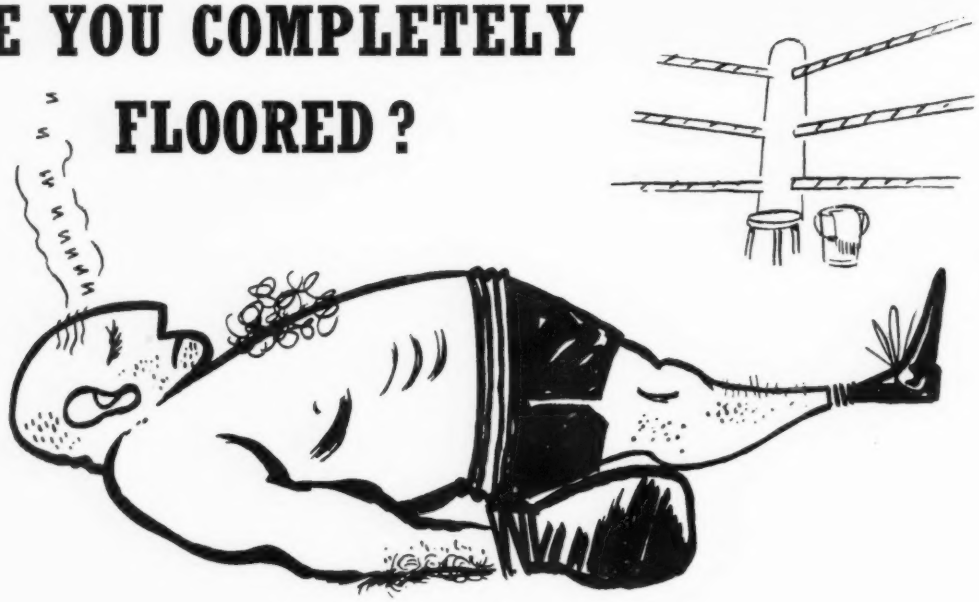


Above, plan showing temporary accommodation designed to ensure clean conditions within the reactor during the placing of the graphite. The "clean" areas, the reactor shell and the access between them were pressurized with conditioned air. Air locks separate these areas from outside.

Graphite laying and clean conditions

The graphite moderator was constructed inside the pressure vessel in prefabricated blocks, each machined to size and shape, of a weight which could be man-handled. The only access to the pressure vessel, through which graphite (1,200 tons of it) could be passed, was by way of the CO_2 pipe outlets. Any particles of dust remaining inside the reactor would not only reduce its efficiency by acting as absorbers of neutrons but would themselves become radio active and in that condition would be circulated with the CO_2 coolant. For this reason elaborate precautions had to be used to ensure cleanliness. Temporary "dirty" and "clean" changing rooms were constructed on the fourth floor and the vessel itself, together with the "clean" areas (diagram left) were pressurized with conditioned air brought in through one of the low-level ducts. The two high-level ducts were then used, one for bringing the graphite into the vessel and the other for the men to get in by who had to handle it. These had to make a complete change of clothing before entering the vessel and had to wear gloves to prevent moisture from the hands coming into contact with the graphite.

ARE YOU COMPLETELY FLOORED?



If our picture depresses you, just consider the awful punishment a floor gets. Especially when it's being jabbed and pummelled (when it's down) by the feet of schoolboys, for instance, or roller-skaters or soldiers. With no Queensberry rules to protect it, how can a floor defend itself? Before you reject the problem as insuperable, remember the tried and trusted material without substitute in this field—

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Programme

It will be realized that construction of reactor buildings, with the closely integrated mechanical and civil work, requires very careful programming to ensure the proper sequence of delivery to site, not only of drawings but also of materials and manufactured items of plant which are built into the structure.

For the Calder project detailed programmes were prepared so that every one concerned, whether in the design offices, or manufacturing components or on site was fully aware of the dates when each stage had to be completed.

Glossary

An authoritative glossary is to be found in *Atomic Energy Research at Harwell* by K. E. B. Jay (Butterworths Scientific Publications), and the following are only abbreviations of a few terms encountered in the context of building.

Alpha particles: one of the products of radio-activity, can be stopped by a sheet of tin-foil. Toxic; very easily absorbed in human tissue. Protective shells must be of air-tight standard.

Atomic pile: see "Nuclear Reactor."

Biological shield: a thick concrete envelope round a reactor; designed to prevent gamma rays (which can only be stopped by density) from getting out.

Beta particles: one of the products of radio-activity. Can be stopped by a thin shield (e.g. 1/10 in. aluminium). Dangers similar to those from alpha particles.

Breeder reactor: a nuclear reactor which produces more "fuel" than it "burns." Generally a "fast" reactor with high "specific rating" operating without a "moderator" and using liquid metal as the means of heat transfer and cooling.

Chemical separation: a method of separating plutonium from uranium by dissolving "irradiated" uranium cartrid es in acid, and separating out the plutonium by a complex process operated by remote control (e.g. Windscale plant).

Control rods: rods of a material (usually boron) which absorbs neutrons. A number of these are inserted through holes in the reactor core, and can be pushed in and out by motors outside the biological shield so as to control the reaction. Similar rods called "shut off" rods drop by gravity into the reactor in the event of the reaction getting out of control. Earlier reactors had control rods and fuel charge entering from adjacent sides, and "shut-off" rods from the top. The later trend (i.e. Calder) is to have all three types entering from the top as this is more convenient to construct and house.

Core: the matrix of a reactor consisting of the "moderator" and the "critical mass" of fissile material within it.

Critical mass: the amount of fissile material necessary to produce the required chain reaction. (In a reactor about 25 tons of uranium).

Curie: A measurement of radiation. A gram of radium has an activity of 1 Curie. A reactor developing 100 Megawatts of electricity will be emitting radiations of a strength of about a thousand million Curies. Research work involving radiations of more than 1 Curie is done in a "hot" laboratory; with radiations of one thousandth Curie (Mille Curie) in a "warm" laboratory; radiations not more than one hundred thousandth Curie (Micro Curie) constitute Tracer Activity (Tracer Laboratories). The maximum weekly dose to which an atomic worker is allowed to be exposed is 0·3 Roentgens (1 Curie of radium at a distance of 1 metre gives a dose of 1 Roentgen per hour).

Gamma Ray: electromagnetic radiation similar to X-rays but of shorter wave-length. Intense penetration from which the only adequate protection is by density, e.g. 7 ft. of concrete of 500 lbs. per cubic ft.

Gaseous diffusion: a method of producing "enriched" uranium. Uranium metal is converted into a gas, uranium hexafloride, which is diffused through plant having a multiplicity of porous membranes (Capenhurst).

Half life: the period of time taken for the radio-activity of a given substance to decay to half its initial value. This may vary from a fraction of a second to millions of years, e.g. plutonium 239 has a half life of 24,000 years. Some isotopes used for medical treatment have a very short half life and must be used within days or hours after irradiation.

Heavy water: water in which the molecules of hydrogen have been replaced by those of a hydrogen isotope deuterium.

Hot area: an area of an atomic plant where the amount of radio-activity present involves using extreme precautions, (e.g., remote control, maintenance by frogmen, etc.) and is marked as such.

Hot box: a sealed protective casing in which radio-active experiments can be handled by remote control.

Irradiation: the processing of a substance by means of neutron bombardment, to make it radio-active.

Isotope: a variant of a substance having the same chemical identity but a different physical one. Isotopes which are radio-active can be made from substances which are not; the 235 isotope of uranium is the only nuclear fuel which occurs naturally in any quantity.

Moderator: part of the core of a reactor. Graphite blocks, heavy and light water, have been used so far. The purpose of the moderator is to slow down the neutrons without absorbing them.

Monitor: a device for testing intensity of radiations, in particular those due to radio-activity.

Nuclear reactor: generally a structure in which continuous nuclear fission can be maintained and controlled, comprising reactor core, thermal shield, and biological shield.

Plutonium: a new element made from uranium. The 239 isotope of Plutonium is important because it is a valuable nuclear fuel and is made from uranium 238 which is comparatively abundant. Because Plutonium is a different chemical element it can be separated from uranium by a chemical process.

Pressure vessel: a steel shell containing the reactor core.

Radiation: emissions thrown out in the radio-active process. Alpha and beta particles and gamma rays. The intensity and type of radiation from a process dictates the construction and services necessary for the building which surrounds it.

Radio-activity: spontaneous atomic disintegration accompanied by the emission of a charged particle and often gamma radiation.

Specific rating: the dimensions of the core of a nuclear reactor are determined by the critical size of uranium charge, and chain reaction can be built up to any intensity which is convenient. In practice the intensity is determined by the ability to transfer heat from the core, and is referred to as the "specific rating" of the fuel.

Thermal shield: the 6-in. thick steel skin round the inner face of the biological shield designed to prevent the concrete from disintegrating under heat.

Uranium: a metal containing 0·7 per cent. of U235 and 99·3 per cent. of U238. Of these two isotopes only U235 is easily fissionable. U238 is useless as a primary fuel but Plutonium 239 can be made from it. "Enriched" uranium, containing a higher proportion of U235, can be made by complicated processing (e.g. gaseous diffusion). The energy released by the complete fission of 1 ton of uranium (U235 and U238) is equivalent to burning 3 million tons of coal.

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MIS-LIT BRAQUES

Not the least stunning thing about the stunning Braque exhibition at the Tate was the suit worn at the Press view by Douglas Cooper, the show's impressario, who looked like England's answer to Liberace. To be serious, though, he has done an extraordinarily good job in assembling a representative and telling collection of Braques from the beginnings until now (and the Tate have done an extraordinarily depressing job in under-, over- and mis-lighting them to the point of virtual invisibility at some hours of the day).

*

As objects of visual pleasure, the big sumptuous recent pictures from his "Studios" sequence are the things to dwell upon; as objects of intellectual stimulation, the cubist paintings and *collages* of 1908-13 are cordially recommended to architects—particularly the *collages*. They are, after all, the first pre-fabricated art-works of the century, Brutalists will recognize the first master of the æsthetics of "materials as found," and anybody who likes to see things done simply, well, and on the scale of genius will admire *The Clarinet*, reproduced right, in which the dominant element is a plain rectangle of grained wallpaper some three feet long. It's not difficult, in front of a work like this, to see why the work of this period of Cubism should have bitten so deeply into architects' imaginations in the 'Twenties.

*

Except in England, of course. A leading design critic, standing in front of this very picture, observed to ASTRAGAL that John Piper had done nothing comparable until 1936. Those days of splendid isolation and twenty-year time-lags are gone for ever now. Case in point: paintings by John Hultberg currently visible at the ICA, which, the handout proudly claims, are seen "without the usual delay of years between New York and London." They are only on show until the middle of this month, so get supersonic, because they have quite a lot to offer those interested in space, construction, space-construction and all that, and are rather handsome into the bargain.

MNEMOSYNE'S YOUNGEST

While we are considering architecture as one of the higher intellectual disciplines, the Third Programme has a shock in store for you. As one who has expended a certain amount of time and energy in patting Prudence Smith and Leonie Cohn on the back for their yeoman service in getting architecture an airing on the Third, ASTRAGAL turned with interest to the Third's self-congratulatory tenth birthday handout to see what the tenth Muse thought of her achievements herself.

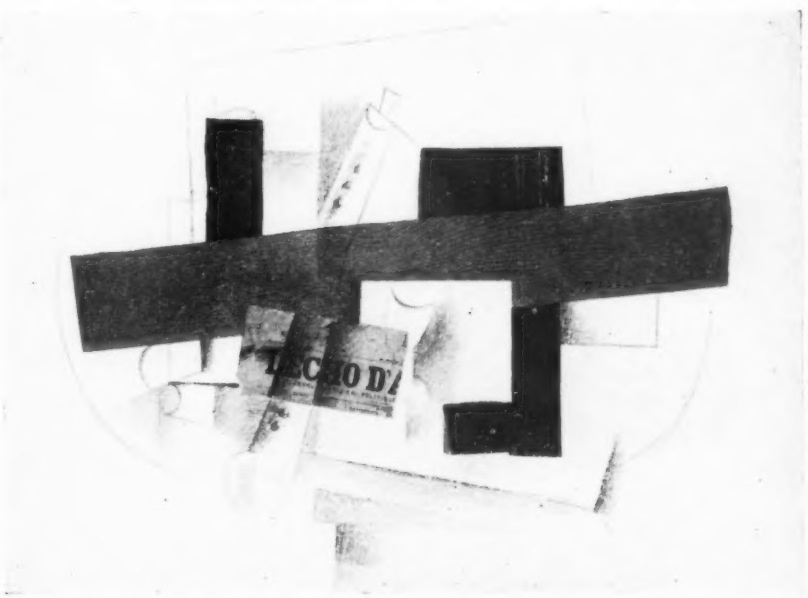
*

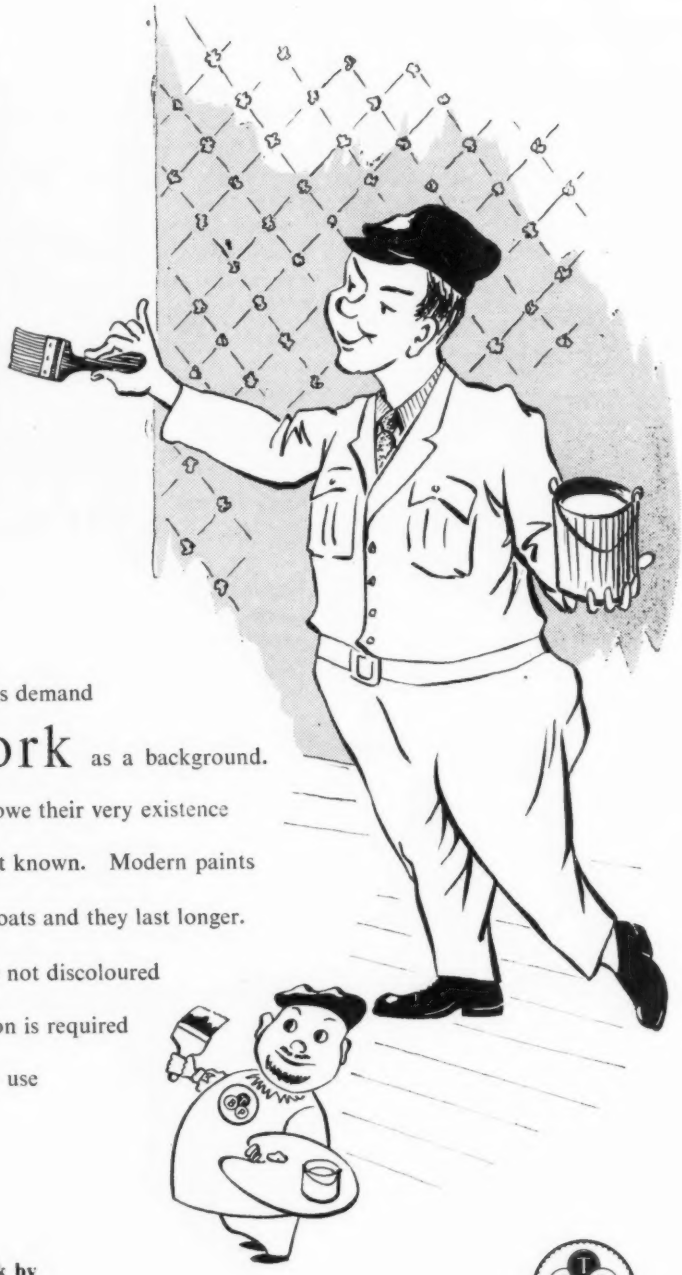
The answer is one mention, in the penultimate paragraph and on the penultimate page out of forty-four, for the series *Prospect*, which the BBC appear to consider as dead, though ASTRAGAL has a feeling that it is quite as much alive as J. M. Richards, to name a contributor to the series who has spoken in the last few weeks. Anyhow, it is clear that those of us who thought that architecture was becoming part of the regular intellectual equipment of the regular English intellectual, of whom the Third is undoubtedly a fair sampling, must think again. Perhaps the drill will be to go back to abusing the Third for not doing more, instead of congratulating it for what it does.

UNINFORMATIVE FORUM

ASTRAGAL went along to the first of the BC's Open Forums, confident that architects and manufacturers were really going to let down their hair and that we were all going to learn why the dickens the manufacturers can't make cheaply what the architect wants and why the stuff they can make cheaply is what the architect doesn't want. The subject was metal windows and the ball was handsomely kicked off by Edward Mills, who pointed out that standard metal windows (BS.990) are made to the wrong sizes and look terrible anyway and that the standard factory sashes (BS.1787) look, and are, worse. He went on to ask why we couldn't have a new standard range of windows of domestic scale and, while we are

Braque's "The Clarinet," 1913. From the current exhibition at the Tate. See above.





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about it, why couldn't we include in this, better ironmongery and a higher standard of fit and finish? And he closed with a rueful comment on the metal window ring.

*

Peter Gardiner, who followed him, after saying how much easier it was to satisfy architects' taste with aluminium than with steel, said that if only architects knew what it would cost to change the standard range they would perish the thought. This was not, it seems, the correct party line, for quite a number of the grand old men of the metal window industry then got up to say that it was not as difficult as all that to change the ranges but that architects had, after all, designed them in the first place, and that there were evident signs that most architects still liked them best. For though the metal window Big Three had launched the Zed Range to supersede the standard ranges, they still sold twice as many standard windows as they did Zeds. They then testified to the great and beautiful friendship that existed between most members of their industry (which architects have never doubted) and said that architects should know how much the *workers* owed to the Metal Window Manufacturers' Association.

*

Though a few small technical points *were* cleared up in the course of the evening, ASTRAGAL came away feeling that if the Building Centre doesn't stage-manage its Forums a bit better and ensure that manufacturers are sufficiently briefed on *some* of the questions so that they can give hard answers on matters of technique and art, the Forums are going to flop. Which would be a pity.

AN EXHIBITION FOR THE UNINFORMED

On the pleasantly refurbished top floor of the BC, until October 27, is the "Built in USA" exhibition. It is an excellent exhibition for laymen and for all those architects, engineers and so on who don't take the American glossies and not many of the British ones either. There are some fine new photographs of familiar American post-war buildings and also—an imaginative touch—some colour transparencies. These, very unfortunately, are extremely bad, on the whole, having the common failing of gross colour distortion.

FREE TRIPS TO RUSSIA

The Russians wash in running water (surely an expensive habit?), and plug-carrying Sir Gordon Russell described his troubles due to this at a meeting of the DIA last week when he gave his impressions of a recent visit to the USSR. (The plug was useless, by the way, the hotel basin had seven holes.) His impressions were much the same as those of every visitor to Russia who has an eye for design, but the record was worth hearing again, none the less. Odd things stood out —the air hostess who wore an "extremely out-of-date blouse," and apparently nothing else; window boxes planted with runner beans; inlaid floors, including one of jasper; half-mile square building sites with up to thirty cranes; 4-class railway accommodation; clean streets; no street advertising; excellent museums and expensive drinks (two beers, two brandies: £4 0s. 0d.).

*

The odd thing about this trip was that Sir Gordon obviously expected to find some examples of good industrial design, and also some industrial designers. As he travelled under the auspices of the British Council, one would have thought that the Council would have undertaken a little preliminary research and investigation before sending him off. A study of Russian magazines would have shown (apart from the accounts of previous travellers—F. R. S. Yorke, Sir Hugh Casson, Cecil Handisyde, and so on) that good industrial design hardly exists—at least to Western eyes. And a letter or two might have discovered that there were no industrial designers for Sir Gordon to meet either. All Sir Gordon was able to report was that the people in charge of manufacture considered design only in so far as it helped or hindered production, and he hazarded a guess that it was just possible that they deliberately made consumer goods unattractive so as not to create too high a demand.

*

That is as may be, but a sniff round any British department store would show such design selling like hot cakes. The more probable reason, surely, for the unfashionableness of Russian goods, is the lack of critics, and of contact with the outside world. Design, in Russia, has been virtually moribund since 1917.

ARMY BUILDING

ASTRAGAL, who along with many of his readers, has spent quite a time in the Army's slums, was pleased to read the announcement last week that a six-man committee has been set up by the Secretary of State for War to review and advise on arrangements for deciding on, and carrying out, Army building work at home and abroad. Some of the members of this committee are men who have had first-hand administrative experience of the best post-war building work done in this country: David Nenk, the Under-Secretary for Finance and Accountant General, of the MOE, and R. S. McDougall, the county treasurer of Herts. The War Office are lucky to have two such acute minds to advise on an extraordinary difficult problem. A third member of the committee is A. G. Sheppard Fidler, Birmingham's City Architect.

*

The Army, ASTRAGAL has been told, employs a large number of architects, and even has its own building research station, but one hears very little of either. The main problem which confronts the Army is the replacement of low-standard barracks. One idea which occurs to ASTRAGAL'S all too facile mind, might be the creation of a prefabricated, largely recoverable, structible system to make accommodation units which can be switched from place to place as our military influence waxes and wanes; or, alternatively, the creation of a building system which is such that the buildings can be readily converted to another use when, as we all hope, the Army can be reduced in size. But before getting to such detail, it is almost certain that the Army will have to look very closely at its own administrative set-up, which is so often the cause for waste in capital expenditure on building. Here again, the experience and advice of Messrs. Nenk and McDougall will be invaluable—let's hope the Army can take it.

PLANNING THAT IS NOT PLANNING

As I write, the result of the public inquiry on the proposed private-enterprise new town at All-Hallows, Kent, has not been announced, so comment must wait. But it's a sad illustration of lack of co-ordination at the top.

*

I believe this site was considered for a new town after the war, but was turned down because of the high agricultural value of the land. But that

didn't stop an oil refinery being built there, which now produces a strong case for building a new town after all. If the planning ministry values agricultural use above building use, and another ministry (presumably Fuel and Power) is allowed to override this, who is really doing the planning in this country—or is no one?

ASTRAGAL

LIVERPOOL

Student Work on View

Speaking at the opening of the exhibition in Bluecoat Chambers of the work of students of the School of Architecture and of the Department of Civic Design, at Liverpool University, Professor Gardner-Medwin said:

"I had asked Lionel Budden to open this Exhibition for us and I knew he was looking forward to doing so; for only a week or two before he died he had walked around the full display of fifth year students' work, hung in the studios ready for judging, and I knew from the way his face lighted up that he was genuinely thrilled at the students' achievements.

"It would have been specially appropriate for him to have opened our exhibition on this occasion. For one reason, these students who have done so well were the last batch he selected, before he retired in 1952, and he was responsible for the grounding they had in their First Year. For another reason, Lionel Budden was President of the Bluecoat Society which has so graciously allowed us to hold our exhibition in their fine building this year."

After referring to the fact that Lionel Budden was an exceptionally modest man who would have been embarrassed at the idea of long speeches about himself on such an occasion, Professor Gardner-Medwin continued:

"I first knew Lionel Budden as a student, in the days of that wonderful partnership between two very different but complementary characters, when he was Associate Professor with Professor Sir Charles Reilly. Students of that generation will bear witness to the powerful contribution he made to the development of the School, and particularly to serious analytical thinking about architecture in the pioneering days of architectural education—long before he took over command himself, in 1933. The man in the limelight then (and how he loved it!) was Reilly. Budden shunned the limelight but went quietly, devotedly about his work—mostly off-stage—reforming the curriculum, raising the standard of scholarship, and above all teaching us to think deeply about the real meaning and logic of architecture. Students of our generation and of this one will agree that he could be a biting critic, but never anything but a fair one."

Referring to the work of the students, Professor Gardner-Medwin said: "The exhibition is a display of the progressive stages of students' work in the School of Architecture from First to Fifth Year, and of the work of students in the post-graduate Department of Civic Design.

"There is a human temptation to show mainly the more intriguing sketches, models and design drawings which we think will appeal to those we are in the habit of describing as the "lay" public. But whether you are professional or lay, I hope you will realise that underneath this apparent sugar icing there is a substantial cake made to the recipe of building science, structural principles and planning logic. For those who wish to examine them, or to be dumbfounded by them, there are some sets of working drawings which show what the student really knows about building.

"I am sometimes asked if we are not overdoing the grounding in the mathematics and science of building knowledge. Though we keep an open experimental mind on this subject I have no evidence that we are overlooking it. I believe that the increasingly scientific attitude to design is beginning to bear fruit in a strengthening of imaginative quality.

"The designs which you see here are not wild dreams though they may appear so in a conservative and unadventurous architectural setting. These projects are serious, practical works, designed according to realistic programmes usually set by real clients, and fully solved, technically and economically. What you see here can no longer be called revolutionary, for this approach to architecture is now firmly established among most architects under 40 and by many under 60. Students, when they reach the end of a University course in Architecture or Civic Design, have still much to learn about professional practice and public office organisation; but in many ways they are in the vanguard of their profession and well equipped, even technically, to solve the most obstinate and complex problems of development in the modern city.

"I believe that full time University training, linked with field work and practical experience, is the only way to ensure that students gain the mental discipline and imaginative power to master modern techniques and solve modern problems. Lionel Budden felt this most strongly and constantly preached the doctrine of the full-time University course."

After announcing that Kevin Campbell, an honours graduate of 1955, had won the Rome Scholarship, Professor Gardner-Medwin continued:

"It is also good to be able to tell you that we awarded our first post-graduate degree of Master of Architecture last session, to a brilliant young American, Ezra Ehrenkrantz, for his thorough study of dimensional co-ordination in terms of the parts played by the architect and by the manufacturer of building components: an important contribution to the study of building economics.

"This degree of Master of Architecture, as distinct from the Master of Arts (in Architecture) awarded for literary or historical studies, is awarded for research of a scientific or practical nature which makes a real contribution to the practice of architecture, and we hope that the School will continue to make post-graduate contributions in this field which will be of value to the profession.

"I want to mention a unique and spirited event which took place last May and which demonstrated the reforming zeal and eager public spirit of our students. I mean the 'Outrage' (or anti-subtopia) exhibition staged entirely by the students in the ruined nave of St. Luke's. There is much to complain of in the desolate appearance of vast areas of our towns and suburbs: and the students, feeling strongly that this is an unjustifiable shame and that architecture is the cure, thought it a public duty to show what architecture can do. We congratulate them for their enterprise and thank the church and the corporation for helping them."

COMPETITION

War Memorial Building

£750 will be awarded to the first prize-winner in a competition for a war memorial building (hall and offices) to be erected in Belfast. H. A. Dod and R. S. Wilshere will assess the designs, which must be submitted by March 30. Questions must be asked by December 14, and conditions can be obtained on payment of £2 2s. deposit—from Captain W. H. Wilson, Hon. Sec., the Council of the Northern Ireland War Memorial (Inc.), 73, King Street, Belfast.

The second prize for this competition, which is open to architects living in Great Britain and Northern Ireland, will be £500. The third will be £300.

MOW

Discussion on Costs

The MOW and Brixton School of Building have arranged a discussion on Elemental Bills of Quantities and Cost Analyses to be held at the Building Centre, W.C.1, at 6 p.m. on October 24. Sir Thomas Bennett will take the chair, and the subject will be introduced by F. J. West, deputy architect to the LCC, Peter Trench, managing director of Bovis Ltd., and James Nisbet, chief quantity surveyor of the MOE, one of the JOURNAL'S Guest Editors (Costs) for 1955. Seat reservations and further information may be obtained from the MOW Technical Information Office, Room 239, Lambeth Bridge House, S.E.1.

NFBTE

National Quantities Rule

The National Quantities Rule of the National Federation of Building Trades Employers states the "members shall not tender in competition for contracts exceeding £3,000 in total value without Bills of Quantities being supplied. In the case of contracts for the repetitive construction of small dwelling houses the Bills of Quantities shall be prepared in accordance with the principles of the Code for the Measurement of Building Work in Small Dwelling Houses. This instruction shall not apply to contracts for repairs or contracts for painting and decorating only."

At its meeting on September 26 the Council of the NFBTE decided to increase the figure of £3,000 in the Rule to £4,000.

DIARY

Post-war Architecture: Built in U.S.A. Exhibition at the BC, 26, Store Street, W.C.1. Monday to Friday, 9.30 a.m.—5 p.m. Saturday, 9.30 a.m.—1 p.m.
UNTIL OCTOBER 27

Clay Bricks and Building Blocks. Building Centre forum with Peter Shepheard, A.R.I.B.A., and T. Boxall, A.M.I.C.E. Chairman, Goutran Goulden. At the BC, 26, Store Street, W.C.1. 6 p.m.
OCTOBER 18

working detail

FURNITURE AND FITTINGS: 60

CLOAKROOM FITTINGS: SCHOOL IN LONDON, S.W.5

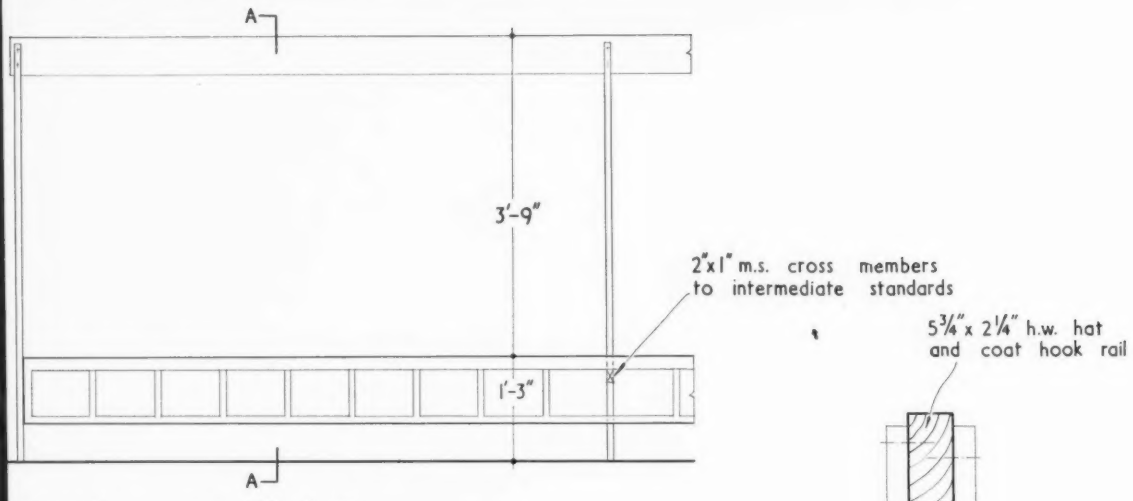
Chamberlin, Powell and Bon, architects

The mild steel bars (which, surprisingly enough, are only 1 *sq. in. cross section) stand on base plates which are sunk into the t. and g. boarding beneath the linoleum floor finish. The hardwood used is sapele mahogany. Coat rails and locker seats are wax polished and locker divisions are oiled. To prevent damage at the seat ends by children climbing up, putting their feet in the lockers and then jumping off, a length of m.s. angle has been screwed to the locker bottom and end in these positions.*

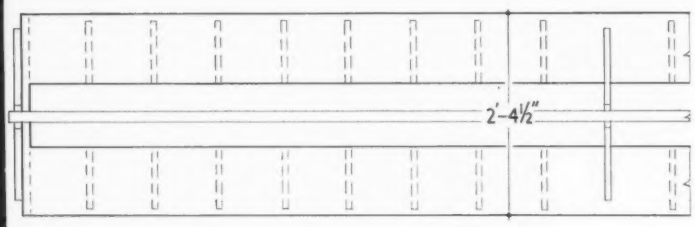
working detail

CLOAKROOM FITTINGS: SCHOOL IN LONDON, S.W.5

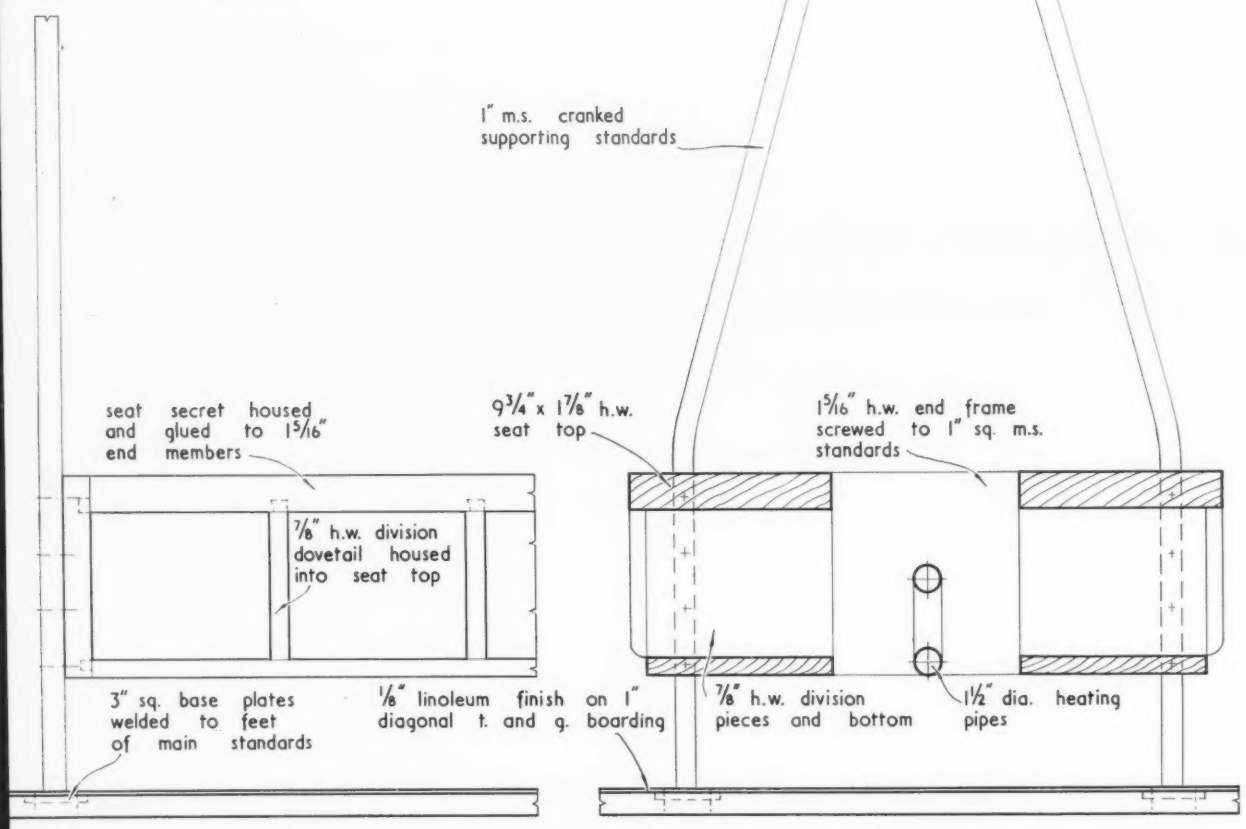
Chamberlin, Powell and Bon, architects



ELEVATION. scale ½" = 1'-0"



PLAN. scale ½" = 1'-0"



PART ELEVATION. scale ½" = 1'-0"

SECTION A-A. scale ½" = 1'-0"

working detail

BALCONIES: FLATS IN LONDON, S.W.1

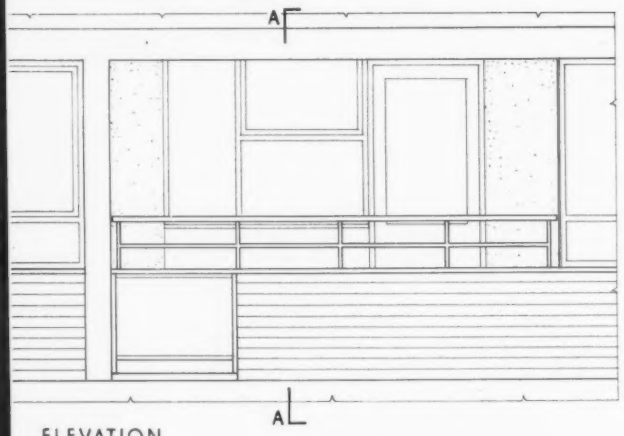
Powell and Moya, architects

The balcony detailed here is situated within a few feet of the projecting balcony detailed in the issue of September 13, *and therefore shows a similar treatment applied to a different situation. To avoid having to dowel metal balusters into a stone or brick coping, the coping is in the form of an inverted channel and is fabricated with the balustrade.*

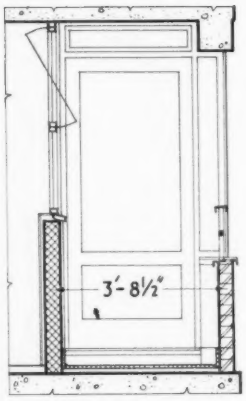
working detail

BALCONIES: FLATS IN LONDON, S.W.1

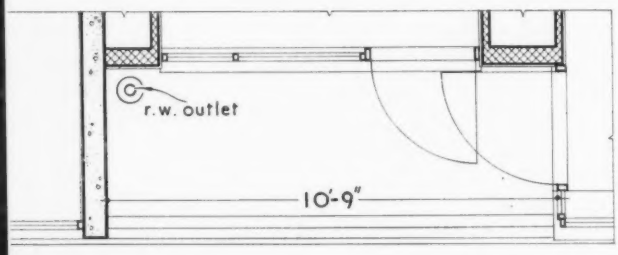
Powell and Moya, architects



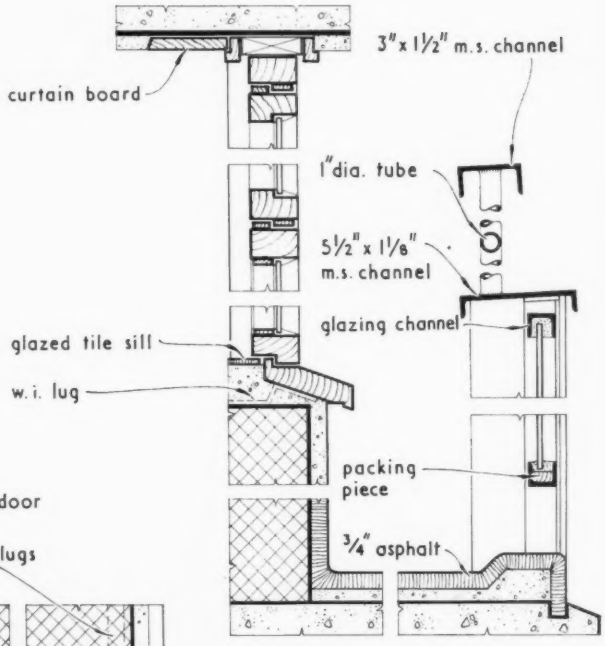
ELEVATION.



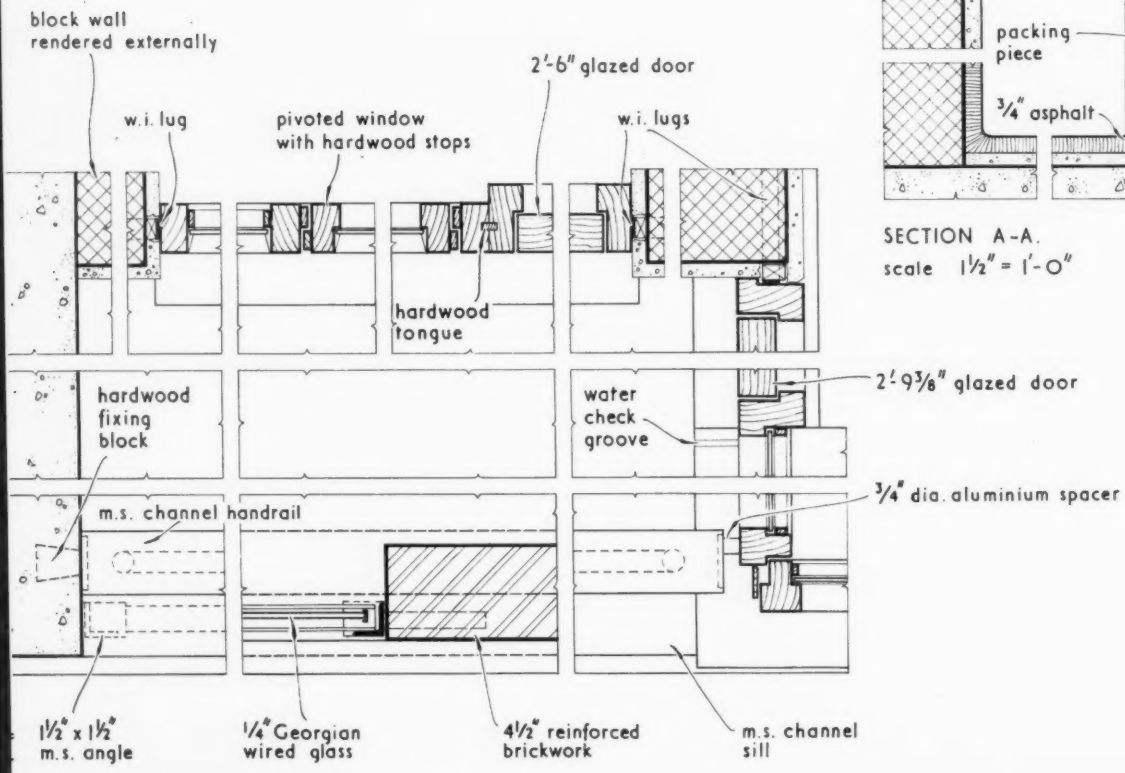
SECTION A-A.



PLAN.
scale ¼" = 1'-0"

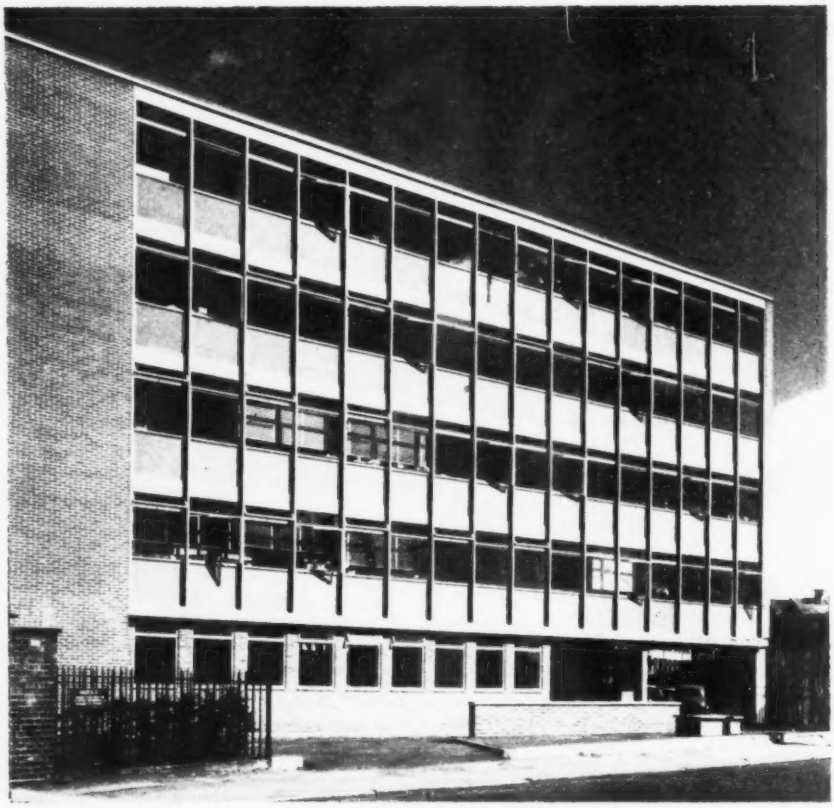


SECTION A-A.
scale 1½" = 1'-0"



PLAN OF BALCONY. scale 1½" = 1'-0"

BUILDINGS IN THE NEWS

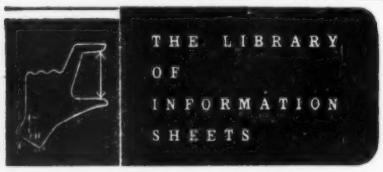


Offices, Beckenham, Kent

A new five-storey office block for Percy Jones (Twinlock) Ltd., has recently been opened at Elmers End, Beckenham, Kent. The building, which was designed by Riches and Blythin, has a reinforced concrete frame entirely made up of pre-cast elements. Because of the poor nature of the sub-soil the block is carried on r.c. piles, with short lengths of pre-cast columns, projecting 8 in. above the ground floor slab, cast into the pile caps. The columns are storey height and have steel plates top and bottom. The pre-cast main beams were propped in position, then connected to the columns, which have corbels with projecting reinforcement at beam level by in situ concrete joints. The floors are made up of hollow 4-in. thick pre-cast units topped by a 2-in. screed, so that all services could be concealed. The infilling for the walls consists of brick work and a type of cladding made up of windows and coloured glass panels. The type of construction used requires a minimum of form work and is quick to erect; work was completed in 13 months. The general contractors were Walker (Tooting) Ltd.; manufacture and erection of concrete frame, Orlit Ltd.

Contractors employed on Atomic Energy projects

Main Contractors. A. Building: W. E. Chivers & Son Ltd., John Laing & Son Ltd., Taylor Woodrow Ltd., Richard Costain Ltd., J. B. Edwards & Co. (Whiteleafe) Ltd., James Crosby & Sons Ltd., Y. J. Lovell & Son Ltd., Thomas & Edge Ltd., Trollope & Colls Ltd., William Press & Sons Ltd., Charles R. Price, Christiani & Nielson Ltd., Concrete Piling Ltd., Lavender McMillan Ltd., George Wimpey & Co. Ltd., C. & J. Seddon Ltd., Harry Neal Ltd., John Mowlem & Co. Ltd., Bance & Co., Alexander Findlay, Thos. Warrington, Beirham & Partners, Hill & Gower, William Moss.



14.F1. *REFERENCE BACK*

Readers are asked to note the following revisions and to amend their copies of the Information Sheet in question. Reverse of Sheet—heading "Sizes and Weights," for 18 *in. substitute* 17⅝ *in. and for* 12 *in. substitute* 11⅝ *in. Heading "Colours," add "Special colours can be produced to order."*

B. Mechanical and Electrical Engineering: Head Wrightson Processes Ltd., Whessoe Ltd., N. G. Bailey & Co. Ltd., Thos. W. Ward Ltd., Cable Jointers Ltd., A. Reyrolle & Co. Ltd., Sulzer Bros. (London) Ltd., Brookhirst Switchgear Ltd., T. Clarke & Co. Ltd., G. N. Haden & Sons Ltd., Matthew Hall & Co. Ltd., Aberfren Cables Ltd., Daniel Adamson & Co. Ltd., Costain-John Brown Ltd.

B. Sub-Contractors. Armstrong Cork Co. Ltd., Aluminium Louvred Ventilators Ltd., Richard Abell & Co. Ltd., D. Adamson, Air Controls Installation Ltd., W. & T. Avery Ltd., Wm. Briggs & Sons Ltd., Brown & Tawse Tubes Ltd., J. H. & W. Bell, Barker & Jones Ltd., John Brook & Son (Bolton) Ltd., Baxendale & Co. Ltd., B.E.F. (Engineers) Ltd., Baggurley Ltd., Barlow Whitney Ltd., British Vacuum Cleaner & Engineering Co. Ltd., British Oxygen Co. Ltd., British Thomson-Houston Co. Ltd., Calomax Ltd., Concrete Piling Co. Ltd., Conroy Ltd., Compton & Sons, Carters Ltd., Colt Ventilation Ltd., Curfew Doors & Shutters Ltd., Chain Link Fencing Ltd., Thomas Clark & Co. Ltd., Cable Jointers Ltd., Clyde Cranes Ltd., Cork Insulation & Asbestos Co. Ltd., Cement Marketing Co. Ltd., Dunlop Rubber Co. Ltd., Faulkner Green & Co. Ltd., Fleetwood Construction Ltd., Ferguson & Harvey Ltd., Floor & Wall Contractors Ltd., Flettons Ltd., Girlings Ferro-Concrete Co. Ltd., Gyproc Products Ltd., Goodlass Wall & Co. Ltd., General Asphalte Co. Ltd., E. Green & Son Ltd., H. Hopper & Son Ltd., Highways Construction Ltd., John Healy (London) Ltd., F. Hancock Ltd., Henry Hargreaves & Sons Ltd., International Construction Co. Ltd., Jaconello Ltd., J. B. Johnson, J. D. Installation Co. Ltd., Korkoid Decorative Floors Ltd., Kelvin & Hughes Ltd., Lightfoot Refrigeration Co. Ltd., A. W. & J. Leigh Ltd., D. Morgan, Sir Alfred McAlpine & Sons Ltd., Mills Scaffold Co. Ltd., Mitchell Construction Co. Ltd., William Mallinson & Sons Ltd., M. A. C. Engineering Bristol Ltd., Merseyside Light Engineering Co. Ltd., Matthews & Yates Ltd., Mitchell Engineering Co. Ltd., Naybro Stone & Co. Ltd., Nadin & Co. Ltd., Neuchatel Asphalte Co. Ltd., Palmers Travelling Cradle & Scaffold Co. Ltd., C. & S. Parkinson Ltd., D. W. Price & Son Ltd., Permanite Ltd., Pochin (Manchester) Ltd., Prick & Co., Rowe Bros. Ltd., Structural Incidentals Ltd., Sulzer Bros. (London) Ltd., Scaffolding (Great Britain) Ltd., Superheater Co. Ltd., Schofields, South Wales Switchgear Ltd., Speedwell Gear Case Co. Ltd., Trollope & Colls Ltd., Trinidad Lake Asphalte Co. (N.W.) Ltd., Turners Asbestos Cement Co. Ltd., Tummel C.M.C., S. Thomson (Kennicut), United Gravel Ltd., United Dairies Engineering Co Ltd., Venesta Ltd., Vaughan Crane, Whitley Moran, Ward (Leigh) & Co., Williams & Williams Ltd., G. & C. Whittle Ltd., William Winstanley Ltd.

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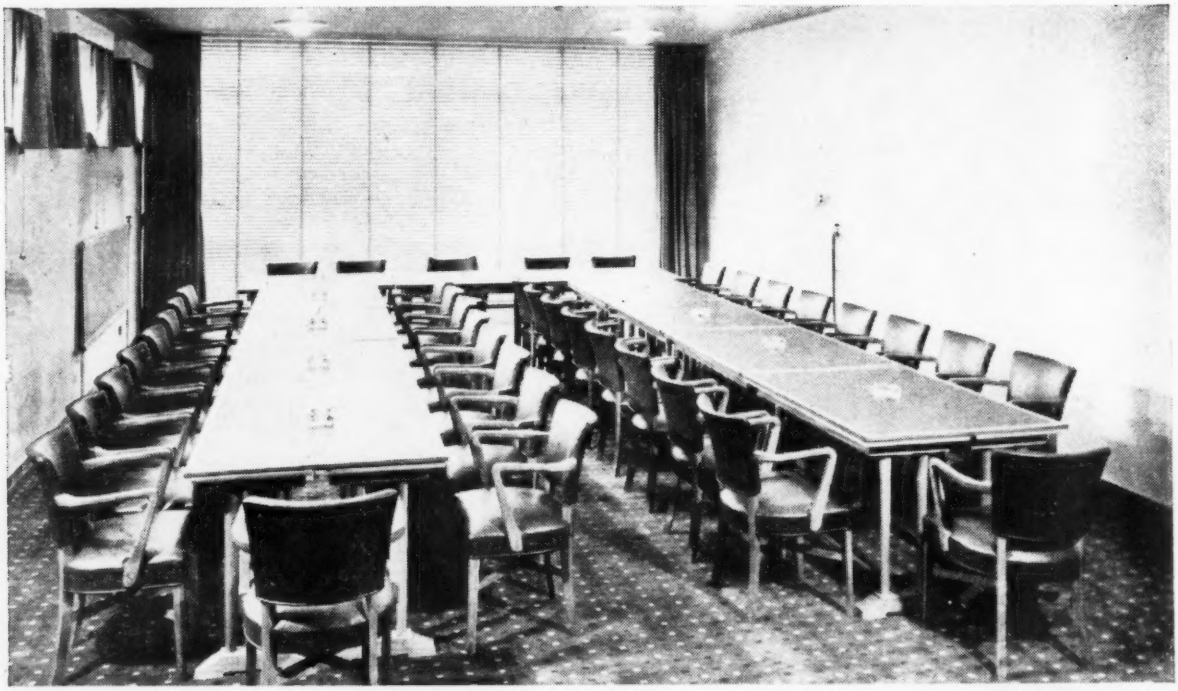

Architects: Easton & Robertson, Chartered Architects

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This dual-purpose room at the British Postgraduate Medical Federation, (University of London) was executed by Catesbys Contracts. The special tables enable full use to be made of the room without giving a makeshift appearance for one or other purpose. When in use as a lecture room, the top surfaces of the desks are wood. For conferences, the tables with the fold-back tops open out on their partners to reveal leather surfaces. Catesbys Contracts made the tables and supplied harmonizing curtains and carpets. If you are faced with making a lot out of a little space, or planning that calls for co-ordination with furnishing you will find that Catesbys co-operate . . . with most satisfying results.

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Siscomatte is a new *rubberised* paint recently developed by Sissons Brothers of Hull, which provides the finest matt finish ever known for interior walls and ceilings.

Siscomatte is not a *chlorinated* rubber paint, and with normal painting technique presents no difficulties in joining up on large surfaces. Yet its rubber base makes it both steam-proof and condensation resistant. For this reason, Siscomatte is ideal for kitchens, bathrooms, restaurants, canteens and many other industrial premises where steam is a problem.

Siscomatte is extremely easy to apply—far easier than ordinary eggshell finishes. It may be brushed or sprayed and requires no working out. Siscomatte dries quickly and evenly —it's touch-dry in about four hours, hard overnight.

Siscomatte has been formulated to produce a velvet-smooth surface which is simple to keep clean, tough enough to be scrubbed and to give maximum resistance to detergents.

Only modern technical knowledge and prolonged research have made it possible to produce a matt wall finish combining at one and the same time all these advantageous properties.

Siscomatte is made in a range of 30 selected colours.

For woodwork, too

Siscomatte is an extremely versatile paint in that it is equally suitable for woodwork or metalwork as for walls. This has led Sissons to develop another new product—Siscoglow.

Siscoglow is a *transparent paint*—not a varnish—and is applied *over* Siscomatte on all woodwork. The result is an extremely attractive subdued gloss finish almost impossible to obtain by any other method.

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This "pearl" finish is quite as practical as a full gloss—it's hard, durable, and doesn't encourage finger-marks—yet it's more restful to the eye. This new decorating scheme, using Siscomatte and Siscoglow, has been named the "Plain and Pearl" effect.

"Plain and Pearl" not only gives a toning, attractive finish to any room—it also saves time on "cutting in" and eliminates the time usually spent matching up matt and gloss paints.

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You may already have been sent a panel painted with Siscomatte and Siscoglow and a tint book. If you haven't, but would like them, please write to Sissons Brothers & Co. Ltd., Bankside, Hull.

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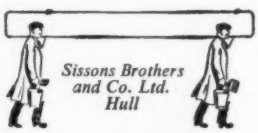

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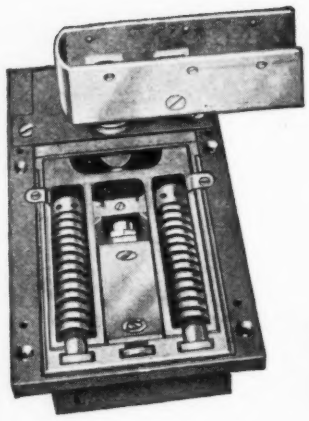

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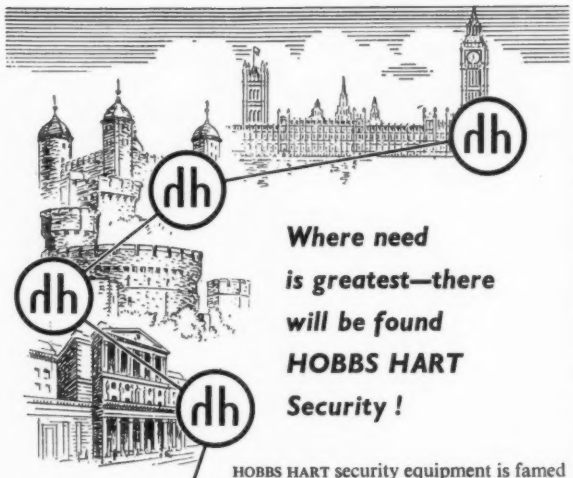

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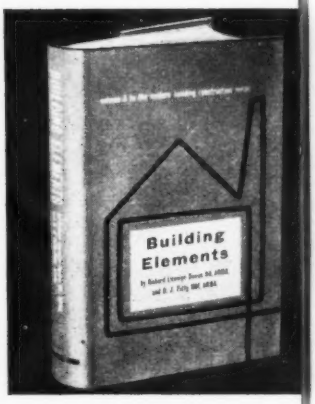

building elements by R. LLEWELYN DAVIES, M.A., A.R.I.B.A. and D. J. PETTY, M.B.E., M.A., A.R.I.B.A. Foreword by W. A. ALLEN, B.ARCH., A.R.I.B.A.

This Book deals with the structural elements of which a building consists, its walls, roofs, floors, windows, etc., and explains the functional requirements a building has to meet. It then describes how these requirements are met in the actual design of the various structural elements.

The book is divided into two parts, the first of which contains chapters on the requirements of building elements under the headings of Design and Expression; Weather Exclusion; Thermal Insulation; Sound Insulation; Fire Protection. In Part 2 chapters deal with the principal kinds of External Walls; Internal Walls; Roofs; Floors; Stairs; Flues and Fireplaces; Windows and Doors; which are in current use, and show how far and in what way, each of these elements fulfils the requirements described in Part 1.

Size: 8¾in. by 5⅝in., containing 384 pages including over 190 diagrams and halftone illustrations. 37s. 6d. net, postage 1s. 4d.

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This book provides up-to-date information on building materials in a form most useful to architectural students and practising architects. In addition to traditional materials, Mr. Handisyde deals with the many new materials which have come into use during the last twenty-five years, and takes full account of the very considerable amount of recent scientific research which has been brought to bear on both old and new materials. He examines thoroughly those problems of increasing concern to architects today—to what extent will alternative materials provide comfortable buildings, buildings that are warm and quiet and reasonably secure against fire, as well as being weatherproof and strong enough for their purpose.

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structure in building by W. FISHER CASSIE, PH.D., M.S., F.R.S.E., M.I.C.E., M.I.STRUCT.E., and J. H. NAPPER, M.A., F.R.I.B.A., A.M.T.P.I. Foreword by W. A. ALLEN, B.ARCH., A.R.I.B.A.

Steel, concrete, aluminium alloys, etc., have revolutionised structural design, and although this field is largely an engineering one, today it is essential for the architect to understand something about it. No attempt is made in the book to give the formulae and methods of analysis and design used by the structural engineer; rather it provides the architect and student with mental pictures of how structures behave, for without the ability to 'feel' how forces act and react in the support of buildings, the architect cannot hope to put into practice the spatial conceptions of present-day architecture.

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Replies to Box Numbers should be addressed care of "The Architects' Journal," at the address given above.

Public and Official Announcements

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NORFOLK COUNTY COUNCIL

Applications are invited for the appointment of CHIEF ASSISTANT ARCHITECT, A.P.T. Grade VI (£880—£1,080), commencing salary according to experience. Candidates must have had good general experience in design, construction and all aspects of handling building contracts, and applications, which must state details of training, qualifications, age, past and present appointments, and the names of three referees, must be received by Mr. C. H. Thurston, County Architect, 27, Thorpe Road, Norwich, not later than October 23rd, 1956. 4015

EAST ANGLIAN REGIONAL HOSPITAL BOARD

Department of the Regional Architect (Guy Aldis, A.R.I.B.A., A.A.Dipl.) for planning of a scheme for the major development of a General Hospital which the Board has commenced.

ASSISTANT ARCHITECTS. Candidates must be qualified and registered architects and have had good general experience in design, construction and specification writing. Knowledge of hospital work desirable. Salary £680—£985; additional increments within the scale based on experience and age may be granted.

Applications stating age, qualifications, experience and details of present position with names of three referees to Secretary of Board, 117, Chesterton Road, Cambridge, by 19th October, 1956. 4054

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Applications are invited for the following appointments on the Staff of the County Architect:—

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(*b*) 1 ENGINEERING ASSISTANT (Heating and Electrical Section).
(*c*) 1 QUANTITY SURVEYING ASSISTANT.

All the above appointments will be on Grade A.P.T. I, £530—£610 or A.P.T. II, £595—£675, or Special Grade, £690—£840 according to qualifications and experience.

All posts are subject to the National Joint Council's Scheme of Conditions of Service, the Local Government Superannuation Act and to a medical examination.

Intending applicants should apply for forms, stating for which post they wish to apply, to the County Architect, County Hall, March, Cambs., to whom they must be returned not later than Saturday, 27th October, 1956.

R. F. G. THURLOW,
Clerk of the County Council.
4065

AIR MINISTRY Works Designs Branch requires in London and Provinces ARCHITECTURAL ASSISTANTS, experienced in planning/preparation of working drawings and details for permanent and semi-permanent buildings.

Salaries in London up to £925 p.a. (men) and £831 (women). Lower in Provinces. Starting pay depending on age, quals. and experience. Long-term possibilities, with promotion and pensionable prospects. 5-day week. 3 weeks, 3 days' leave a year. Liability for overseas service. Normally natural born British subjects. Write, stating age, quals., employment details., incl. type of work done, to any Employment Exchange, quoting Order No. Borough 1000. 3029

DERBYSHIRE COUNTY COUNCIL
COUNTY ARCHITECT'S DEPARTMENT

Vacancies for ARCHITECTS. Salary range £690 to £970—on grades Special, IV and V of the National Joint Council A.P.T. scales. These three grades are merged to provide a continuous progression to the maximum of Grade V, subject to satisfactory service. Commencing salaries in accordance with experience and qualifications. Pensionable posts. Canvassing disqualifies.

Details and application forms from F. Hamer Crossley, Dipl.Arch.(L'pool), F.R.I.B.A., County Architect, County Offices, St. Mary's Gate, Derby. 4096

HAMPSHIRE

Applications are invited for the appointment of a TECHNICAL ASSISTANT in the County Planning Department on Grade III of the National Scales (£640—£765), to work in the South-East Area Office at Fareham. Candidates should have passed the Intermediate Examination of the Town Planning Institute or of a related professional body, and have had experience in the Planning Department of a Local Authority. The appointment is pensionable and will be subject to a satisfactory medical report.

In approved cases the County Council assist with removal and other expenses. Applications, stating age, education, qualifications and experience, with a copy of one testimonial and the names of two referees, should reach the County Planning Officer, Litton Lodge, Clifton Road, Winchester, by the 20th October. 4098

NORTH WEST METROPOLITAN REGIONAL HOSPITAL BOARD

ASSISTANT QUANTITY SURVEYOR required. Applicants should be Associate Members of the R.I.C.S. and be thoroughly experienced in taking-off, abstracting, and billing of quantities, measurement of work in progress, and settlement of final accounts.

Salary scale: £640 × £25 (4) × £30 (4) × £35 (2)—£930, plus £20—£40 London weighting. Improved scale expected. Salary above minimum may be paid according to appropriate experience since obtaining qualification.

Applications, stating age, qualifications (with dates) and experience, together with names of two referees, to Secretary, North West Metropolitan Regional Hospital Board, 11a, Portland Place, W.1, by 3rd November. 4099

COUNTY COUNCIL OF NORTHUMBERLAND.
COUNTY ARCHITECT'S DEPARTMENT

Applications are invited for the post of ASSISTANT QUANTITY SURVEYOR on the permanent staff of this Department. Salary on A.P.T. scales, Grade IV, £710 per annum, rising by five annual increments of £35 to a maximum of £885 per annum.

Applicants should have experience in the preparation of bills of quantities, measurement of work on site, and preparation of interim valuations and final accounts, and preference will be given to those who have passed the Final Examination of the Royal Institution of Chartered Surveyors (Quantities Sub-Division).

Applications, giving full details of age, education, qualifications, and previous experience, together with the names and addresses of two referees to whom reference can be made, should reach this office not later than 22nd October, 1955.

The appointment will be subject to the provisions of the Local Government Superannuation Acts, and the successful candidate will be required to pass a medical examination.

C. C. BROWN, A.R.I.B.A.,
County Architect.
County Hall, Newcastle upon Tyne, 1. 4095

Applications are invited for appointment to the post of ARCHITECT in the Lands and Works Department, GIBRALTAR. The post is permanent and pensionable and on probation for two years. Salary scale: £720 × £24 to £840, then £960 × £30 to £1,200 per annum. Entry into the scale will be in accordance with post graduate experience. Leave on full salary and return passages to U.K. for officer and wife granted once every two years.

Candidates must be A.R.I.B.A. and have good knowledge of design and construction. Duties will include design and execution of building projects. The successful candidate will work under the Commissioner of Lands and Works, and is required to assume duties early December, 1956.

Unfurnished quarters and basic furniture, if available, will be provided at rents not exceeding 10 per cent of salary and 3 per cent. of value respectively.

Applications, stating qualifications, age, previous experience, and enclosing testimonials, a birth certificate and a recent photograph, should reach the Colonial Secretary, Gibraltar, not later than 8th November, 1956. 4103

NORTHAMPTON

(*a*) ASSISTANT ARCHITECT, A.P.T. IV (£710—£885).
(*b*) ARCHITECTURAL ASSISTANT, A.P.T. III (£640—£765).
(*c*) DRAUGHTSMAN, A.P.T. I (£530—£610).

Full details and application forms returnable by 22nd October, 1956, may be obtained from Borough Architect, Guildhall, Northampton.

C. E. VIVIAN ROWE,
Town Clerk.
4109

DURHAM COUNTY COUNCIL
PLANNING DEPARTMENT

ARCHITECT PLANNER. Salary £975—£1,200. Successful applicant will be in charge of a small design group dealing with the preparation of housing and redevelopment layouts, town centre layouts, village plans, and the control of elevations. Applicants must be Members of the Royal Institute of British Architects, and preference will be given to those who are also Members of the Town Planning Institute. Applicants should have had considerable practical experience of design problems.

SENIOR PLANNING ASSISTANT. Salary £795—£970. Applicants must be Associate Members of the Town Planning Institute, and preference will be given to those holding an architectural qualification. The successful applicant should have design ability and experience for work in the design group.

ASSISTANT AREA PLANNING OFFICER. Salary £795—£970. Must be Associate Members of the Town Planning Institute, and have had at least three years' experience since qualifying in all aspects of development control work, and preferably some experience of Town Maps.

DRAUGHTSMAN. Salary £530—£610.

Housing available—Perterlee, 12½ miles; Newton Aycliffe, 12 miles from Durham. Forms and particulars from County Planning Officer, 10, Church Street, Durham. Closing date: 27th October, 1955.

Canvassing members of the Council is prohibited.

J. K. HOPE,
Clerk of the County Council.
4110

COUNTY BOROUGH OF DARLINGTON
BOROUGH ARCHITECT'S DEPARTMENT

Applications are invited for the appointment of ASSISTANT ARCHITECT, at a salary in accordance with Grade A.P.T. IV (£710—£885), commencing at a point within the grade, according to ability.

The department has a large programme, including Secondary and Primary Schools, Housing and Municipal Buildings. Preference will be given to candidates experienced in this class of work and who are Members of the R.I.B.A.

Consideration would be given to the question of providing housing accommodation if required.

Applications, giving age, qualifications, present appointment and salary, previous appointments with dates, and names and addresses of three referees, to be sent to the Borough Architect, Central Buildings, Darlington, not later than Monday, 22nd October, 1956. 413

BUCKS COUNTY COUNCIL

Applications are invited for the appointment of an ASSISTANT STRUCTURAL ENGINEER in the County Architect's Department. Salary A.P.T. Grade V, £795 × £35 (5)—£970 p.a., according to experience.

Applicants must have had all-round experience in design and detailing of reinforced concrete and steel structures.

A weekly allowance of 25s. and return fare home once every two months may be paid for six months to newly appointed married officers of the Council unable to find accommodation.

Applications, on forms to be obtained from F. B. Pooley, County Architect, County Offices, Aylesbury, must be returned by 20th October, 1956. 408

COUNTY BOROUGH OF MERTHYR TYDFIL
PERMANENT APPOINTMENT OF TWO SENIOR ARCHITECTURAL ASSISTANTS

Applications are invited for the above appointments at a salary in accordance with Grade A.P.T. V (£795 × £35—£970 p.a.) of the National Scheme of Conditions of Service.

Applicants must be Associate Members of the Royal Institute of British Architects, and must have had good all round experience in the architectural work usually undertaken by the Local Authority. Planning experience would be an advantage.

Housing accommodation will be provided if required, and reasonable removal expenses of the successful applicant will be paid.

The appointment will be subject to the Local Government Superannuation Acts and to the passing of a medical examination. The appointment will be terminable by one month's notice on either side.

Applications, stating age, past and present appointments, qualifications and experience, together with copies of three recent testimonials, should be delivered to the undersigned not later than 12 noon on Friday, the 19th October, 1956.

Canvassing in any form will disqualify.

T. S. EVANS,
Town Clerk.
Town Hall. Merthyr Tydfil. 408

COUNTY BOROUGH OF SOUTHAMPTON
BOROUGH ARCHITECT'S DEPARTMENT

Applications are invited for the following permanent appointments:—

(*a*) SENIOR ASSISTANT PLANNING OFFICER, Grade A.P.T. V (£795—£970). Applicants should be Members of the Town Planning Institute, and preferably hold a qualification in landscape architecture. Duties offer considerable scope for preparing and executing schemes of urban landscaping in addition to normal planning work.

(*b*) ASSISTANT PLANNING OFFICER, Grade A.P.T. IV (£710—£885). Applicants should be Members of the Town Planning Institute, and preferably hold an architectural qualification. Duties will include architectural aspects of planning, particularly in connection with Central Area reconstruction.

(*c*) PLANNING ASSISTANT, Grade A.P.T. I (£530—£610).

Candidates should state their housing needs.

Application forms from the Borough Architect, Civic Centre, Southampton. Closing date: 27th October, 1956. 408

CITY OF SHEFFIELD
CITY ENGINEER AND SURVEYOR'S DEPARTMENT
SENIOR PLANNING ASSISTANT, GRADE A.P.T. V.

Applications are invited for the position of Senior Planning Assistant, Grade A.P.T. V (£795—£970), on the staff of the City Engineer and Surveyor and Town Planning Officer (H. Foster, M.I.C.E., M.I.Mun.E.).

Qualifications: A.M.T.P.I., A.R.I.B.A., or A.R.I.C.S. Preference will be given to candidates with Planning and Architectural experience.

If housing accommodation is required a flat will be made available.

Superannuable post, N.J.C. conditions of service, medical examination.

Applications, stating age, education and training, qualifications, experience, present and past appointments (with dates and salaries), and quoting the names of two referees, should be submitted to the undersigned by the 22nd October, 1956.

JOHN HEYS,
Town Clerk.
Town Hall, Sheffield, 1. 4079

CITY OF WORCESTER
CITY ENGINEER AND SURVEYOR'S DEPARTMENT
APPOINTMENT OF QUANTITY SURVEYOR

Applications are invited for this permanent appointment on A.P.T. Grade IV (salary £710, rising to £885 per annum).

Candidates must have had considerable experience in the preparation of Bills of Quantities, estimating, measurements on site and the settlement of accounts for building work. Preference will be given to Associates of the Royal Institute of Chartered Surveyors.

This appointment is subject to the provisions of the Local Government Superannuation Act, 1937, and the successful candidate will be required to pass a medical examination.

Housing accommodation will be made available to the successful candidate.

Applications, giving names of two referees, to be delivered to the City Engineer and Surveyor, 22, Bridge Street, Worcester, by Wednesday, the 17th October.

BERTRAM WEBSTER,
Town Clerk.

Guildhall, Worcester. 4078

CITY OF ROCHESTER
ARCHITECTURAL ASSISTANT

Applications are invited for the above appointment in the City Surveyor's Department at a salary in accordance with A.P.T. Grade II of the National Scale of Salaries, *viz.*, £595—£675 per annum. The commencing salary will be according to qualifications and experience.

Candidates should have general experience, including the preparation of drawings and specifications for Municipal housing schemes.

There is a varied programme of work, including the redevelopment of clearance areas and the development of a large area added to the City.

In an appropriate case the City Council will provide the successful candidate with suitable housing accommodation.

The appointment will be subject to the National Scheme of Conditions of Service, the Local Government Superannuation Acts, a satisfactory medical examination, and one month's notice on either side.

Applications, stating age, qualifications and experience, together with the names and addresses of three persons to whom reference may be made, should be delivered to the City Surveyor, 66, Maidstone Road, Rochester, not later than Monday, 22nd October, 1956.

PHILIP H. BARTLETT,
Town Clerk.

Guildhall, Rochester.
1st October, 1956. 4077

BANFF COUNTY COUNCIL invite applications for the post of COUNTY ARCHITECT AND PLANNING OFFICER on salary scale £1,415×£52—£1,675 per annum. J.N.C. for Chief Officials (Scotland) conditions apply, and a car allowance is payable under the Council's scheme.

Applicants should have extensive experience of local authority architectural work, particularly school work, as there is a large capital programme to be undertaken, and should be familiar with planning procedure to the stage of submission of the Development Plan and dealing with planning applications.

Applications, stating age, qualifications and experience, with copies of three recent testimonials, to be lodged with the County Clerk, County Buildings, Banff, by 19th October, 1956. 4089

BOROUGH OF LUTON
TECHNICAL STAFF
MAINTENANCE ENGINEERING ASSISTANT

required. Salary A.P.T. III/IV (£640—£885). Experienced in design of low pressure hot water, steam heating and ventilating installations. Knowledge of electrical installations an advantage. Housing accommodation available. N.J.C. Service Conditions.

Application forms from Borough Architect, Town Hall, Luton, returnable by 7th November, 1956. 4076

CENTRAL ELECTRICITY AUTHORITY
EAST MIDLANDS DIVISION

Applications are invited for the following appointment:—

SENIOR AND ENGINEERING DRAUGHTSMEN, Transmission Department, Divisional Headquarters. (Vacancy No. 175/56/AJ.)

The work is associated with H.V. Sub-Stations and Transmission Lines, and some general Electrical or Civil Engineering experience would be an advantage.

Salary, according to experience, in accordance with Grade 5 (£700—£800 per annum) or Grade 6 (£560—£680 per annum) of the National Joint Board Agreement, Schedule "D."

Closing date for receipt of applications: 29th October, 1956.

The appointments will be pensionable within the terms and conditions of the Central Electricity Authority and Area Boards (Staff) Superannuation Scheme.

Applications should be submitted on the official form AE6/ACT, which may be obtained from the Divisional Establishments Officer, Central Electricity Authority, East Midlands Division, P.O. Box 25, Barker Gate, Nottingham, and returned to the undersigned. Please quote Vacancy Number.

L. F. JEFFREY,
Divisional Controller.
4117

SURREY COUNTY COUNCIL

Applications invited for following appointments:—

(1) ASSISTANT ARCHITECT, Grade IV-VI, minimum £710, maximum £1,080 p.a., plus £30 L.A.
(2) ARCHITECTURAL ASSISTANT, Grade I-III, minimum £530, maximum £765 p.a., plus L.A.
(3) ASSISTANT QUANTITY SURVEYOR, Grade IV-VI, salary as (1) above.

Salary range of appointment and commencing salary will depend on experience and qualifications.

Full details, present salary, and 3 copy testimonials, to County Architect, County Hall, Kingston, as soon as possible. 4115

BOROUGH OF BEXLEY
ARCHITECTURAL DRAUGHTSMAN

Applications are invited for this appointment at a salary in accordance with Grade A.P.T. II (£595—£675 per annum), plus London weighting.

Applicants should be good draughtsmen and have a general knowledge of building construction and specification work.

Forms of application with conditions of appointment obtainable from Borough Engineer, West Lodge, Broadway, Bexleyheath, to whom completed applications must be returned by 22nd October, 1956.

Canvassing will disqualify.

ARTHUR GOLDFINCH,
Town Clerk.
4087

LEEDS REGIONAL HOSPITAL BOARD

Applications are invited for the following appointments:—

(*a*) ARCHITECTURAL ASSISTANT. Applicants must have passed the Intermediate Examination of the R.I.B.A. and have had a sound architectural training and some practical experience in a practising architect's office is essential. The successful applicant will be engaged on the working drawings of a new hospital.

(*b*) TWO QUANTITY SURVEYING ASSISTANTS. Applicants must have passed the Intermediate Examination of the R.I.C.S. or a recognised equivalent examination.

Salary scale: £510—£710 per annum. Commencing salary according to age and experience since passing the appropriate Intermediate Examination.

Applications, giving full particulars, together with the names of two referees, to the Secretary, Park Parade, Harrogate. 4124

GOVERNMENT OF NORTHERN IRELAND
ARCHITECTURAL ASSISTANTS

Applications are invited from Architectural Assistants with recognized training and fair experience for unestablished posts in the Chief Architect's Branch, Directorate of Works, Ministry of Finance.

The salary scale including pay supplement is £469 rising to £761. The inclusive starting pay of candidates who have passed the R.I.B.A. Intermediate Examination will be £596. Entry points for other candidates will be fixed in relation to their ages, e.g., £469 at age 21—£549 at age 25 or over. This scale is under review.

Preference will be given to candidates who served in H.M. Forces in the 1914-18 or 1939-45 wars, provided that such candidates are, or within a reasonable time will be, able to discharge the duties efficiently.

Application forms may be obtained from the Director of Establishments, Ministry of Finance, Stormont, Belfast. 4132
F23/9/25/7/56.

GOVERNMENT OF NORTHERN IRELAND
ASSISTANT ARCHITECT

Applications are invited for the unestablished post of Assistant Architect Class II in the Works Directorate, Ministry of Finance.

Salary scale, which attracts pay supplement of amounts between £91 and £160 per annum, is £675 × £25 — £750 × £30 — £960 × £40 — £1,000. Minimum of scale is linked to entry at age 26 plus or minus one increment for each year above or below that age. Maximum entry point £900 plus pay supplement of £118. This scale is under review.

Candidates must be Registered Architects by examination ,and must have had at least two years' experience in an Architect's Office in the preparation of working drawings for new buildings.

Preference will be given to a suitably qualified candidate who served in H.M. Forces during the 1914-18 or 1939-45 wars, provided the Ministry is satisfied that such a candidate is, or within a reasonable time will be, able to discharge the duties of the post efficiently.

Application forms may be obtained from the Director of Establishments, Ministry of Finance, Stormont, Belfast, to whom they must be returned, together with copies of two recent testimonials. 4131
F21/5/25/5/56.

COUNTY BOROUGH OF SOUTHEND-ON-SEA
EDUCATION COMMITTEE

Principal: T. L. MORGAN, M.Sc., A.M.I.C.E., A.M.I.Struct.E.

Applications are invited for the following post:—

STUDIO MASTER in the School of Architecture (Asst. Grade B). Salary scale: £650×£25—£1,025, with additions for training, graduation, and good honours degree.

Further particulars and forms of application may be obtained from the undersigned (stamped addressed foolscap envelope).

Completed forms should be returned within 14 days to the Principal, Municipal College, Victoria Circus, Southend-on-Sea.

D. B. BARTLETT,
Chief Education Officer.

Education office,
Warrior Square, Southend-on-Sea. 4072

BOROUGH OF WATFORD
APPOINTMENT OF ARCHITECTURAL ASSISTANT

Applications are invited for the above appointment within Grade APT II (£595—£675 per annum).

Forms of application returnable by 25th October, 1956.

F. C. SAGE,
Borough Engineer, Surveyor and Architect.
Town Hall,
Watford. 4125

CITY OF NOTTINGHAM
HOUSING ARCHITECT'S DEPARTMENT

Applications are invited from persons of R.I.C.S. final examination standard for appointment as Assistant Quantity Surveyor, Grade A.P.T. 5 (£795—£970) in the Quantity Surveying Section of the above department.

There is a large programme of interesting and varied work.

Applications for this appointment under N.J.C. service conditions should be sent to the City Housing Architect, The Guildhall, Nottingham, by the 31st October, 1956, stating age, qualifications, experience, present appointment, and names of two persons to whom reference can be made.

T. J. OWEN,
Town Clerk.

The Guildhall,
Nottingham. 4126

BOROUGH OF MAIDENHEAD
BOROUGH ENGINEER AND SURVEYOR'S DEPARTMENT

Applications are invited for the appointment of an ARCHITECTURAL ASSISTANT on Grade I or II of the National Scales (£530—£610, or £595—£675).

Candidates should have passed the Intermediate Examination of the Royal Institution of British Architects or an equivalent examination. The appointment will be subject to:—

(1) The National Scheme of Conditions of Service.
(2) The Local Government Superannuation Acts.
(3) The satisfactory passing of a medical examination.
(4) Termination by one month's notice on either side.

Applications, stating age, qualifications and experience, accompanied by copies of two recent testimonials, must be sent in envelopes endorsed "Architectural Assistant," to the Borough Engineer and Surveyor, 14, Craufurd Rise, Maidenhead, not later than the 26th October.

Canvassing will be a disqualification, and candidates must disclose whether to their knowledge they are related to any member or senior officer of the Council.

STANLEY PLATT,
Town Clerk.

Guildhall, Maidenhead.
September, 1956. 4081

CITY OF LONDON—PLANNING OFFICE

JUNIOR ASSISTANT (male or female), £7 18s. to £8 4s., for general duties in the drawing office; including filing, binding drawings, stencil lettering, tracing, etc.

Applications with details of experience, present position, age, and references, to City Planning Officer, 55-61, Moorgate, E.C.2, within 14 days. 4135

BOROUGH OF DEAL

Applications are invited for the appointment of ASSISTANT ARCHITECT in the Borough Engineer's Department. Salary Grade A.P.T. III (£640—£765).

Candidates must have passed the Intermediate Examination or its equivalent, and should have practical experience in the work of a Municipal authority.

The appointment will be subject to the provision of the Local Government Superannuation Acts and to one month's notice on either side.

Housing accommodation will be available if required, and payment of part removal expenses will be considered.

Applications, with copies of two recent testimonials, should be sent to the Borough Engineer, Municipal Offices, Deal, not later than 26th October, 1956.

E. S. DIXON,
Town Clerk.

Municipal Offices, Queen Street,
Deal, Kent. 4136

COUNTY BOROUGH OF SOUTHEND-ON-SEA
BOROUGH ARCHITECT'S DEPARTMENT

Applications are invited for the following posts:—

ASSISTANT ARCHITECT, A.P.T. IV (£710×£35—£885).

ASSISTANT ARCHITECT, Special Grade (£690×£30—£840).

DRAUGHTSMAN, A.P.T. I (£530×£20—£610).

SENIOR HEATING ENGINEERING ASSISTANT, A.P.T. V (£795×£35—£970).

SENIOR ASSISTANT QUANTITY SURVEYOR, A.P.T. V (£795×£35—£970).

ASSISTANT QUANTITY SURVEYOR, A.P.T. IV (£710×£35—£885).

A recent award of 2½ per cent. increase is additional to these salaries.

Candidates must be suitably qualified and experienced.

The appointments will be subject to the provisions of the Local Government Superannuation Acts and the National Joint Council's Scheme of Conditions of Service so far as adopted by the Council. Successful candidates will be required to pass a medical examination.

Applications, stating age, qualifications and experience, with the names of two persons to whom reference can be made, should be submitted to the Borough Architect, 30, Alexandra Street, Southend-on-Sea, by Monday, 29th October, 1956.

Canvassing will disqualify. Any candidate who is related to a member or officer of the Council is required to disclose the fact.

ARCHIBALD GLEN,
Town Clerk.
4139

COUNTY BOROUGH OF ROTHERHAM
ARCHITECTURAL ASSISTANTS

Applications are invited for the following appointments:—

(*a*) ARCHITECTURAL ASSISTANTS (three vacancies), at a salary in accordance with the Special Grade (£690—£840).
(*b*) SENIOR ARCHITECTURAL ASSISTANT, at a salary in accordance with Grade A.P.T. IV (£710—£885).

Candidates for (*a*) are required to have passed Parts I and II of the R.I.B.A. Final examination, and (*b*) to be Associate Members of the R.I.B.A. with good general experience in design and construction, and the commencing salary in the grade will be according to capabilities and experience.

Applications, to be endorsed "Architectural Assistants," stating age, qualifications and details of experience, together with the names of two referees, should be received by me not later than Monday, the 5th November, 1956.

Canvassing will disqualify.

JOHN S. WALL,
Town Clerk.

Municipal Offices, Rotherham.
3rd October, 1956. 4123

Architectural Appointments Vacant

4 lines or under, 7s. 6d.: each additional line, 2s.

CROYDON.—ARCHITECTURAL ASSISTANT required immediately for interesting and varied work. Inter./Final standard; capable of running small contracts.—Write age, experience, and salary required, to George Lowe & Partner, 4, High Street, Croydon, Surrey. 1951

ARCHITECTURAL ASSISTANT required in busy London office with varied practice. Good salary and prospects for suitable applicant. 5-day week. Write, giving particulars of age, qualifications, experience, etc., to Box 775, c/o 7, Coptic Street, W.C.1. 9313

CO-OPERATIVE WHOLESALE SOCIETY LTD. ARCHITECT'S DEPARTMENT, MANCHESTER

SHOPFITTING DRAUGHTSMAN required, experienced in shop equipment and modernisation of interiors.

The position calls for the preparation of layouts and perspectives with a modern approach to store fitting problems.

The post is pensionable, subject to medical examination and there is a five-day week in operation.

Applications giving age, details of previous experience and salary required to G. S. Hay, A.R.I.B.A., Chief Architect, Co-operative Wholesale Society, Ltd., 1, Balloon Street, Manchester 4. 3056

POST-INTERMEDIATE ASSISTANT required, in large London Office with widely varied practice. Lewis Solomon, Son & Joseph, 21, Bloomsbury Way, London, W.C.1. Telephone HOL 7082. 3152

ARCHITECTURAL ASSISTANT required, Final Standard, for variety of work in connection with exhibition and ancillary buildings. Good salary and working conditions. Write, in first instance, giving details of age, training and experience, if any, to Staff Architect, Olympia Limited, Kensington, W.14. 3150

ARCHITECTURAL ASSISTANTS required, approaching or at Intermediate stage. Up to £550 p.a. D. Plaskett Marshall, F.R.I.B.A., 59, Gordon Square, W.C.1. MUS 7176/7. 3289

ARCHITECTURAL DRAUGHTSMAN required by Company specialising in all types of permanent timber buildings and constructional woodwork generally, both for home and overseas. Good salary and excellent prospects for man with planning and designing ability and capable of working on own initiative. Pension Scheme in operation. Write giving full details of age, experience, qualifications, etc., Medway Buildings & Supplies, Ltd., Phoenix Wharf, Rochester, Kent. 3266

WEST END Architects require ASSISTANT for preparation of working drawings. Some office experience essential, together with a sound knowledge of building construction. State salary required.—Box 4049.

MAJOR Petroleum Company requires for its London office an ARCHITECTURAL ASSISTANT for work on varied commercial projects. Applicants must be of Intermediate R.I.B.A. standard, with sound knowledge of construction and have had a minimum of five years' private office experience. Salary according to experience. Position will be permanent and pensionable. Excellent working conditions, staff restaurant, sports club, etc.—Apply in writing, giving full details of age, qualifications and experience, to Box 4009. Replies can only be sent to those selected for interview. 4009

TREHEARNE & NORMAN, PRESTON & PARTNERS have vacancies for SENIOR AND JUNIOR ASSISTANTS. Salaries according to experience and qualifications.—Apply: 83, Kingsway, W.C.2 (HOL. 4071). 3028

CITY ARCHITECTS' OFFICE require experienced ASSISTANT with contemporary outlook. Commencing salary £900 per annum; congenial office conditions. Box 3279.

ARCHITECTURAL ASSISTANT, Intermediate standard, required immediately for busy general practice.—Write, stating age, experience, and salary required, to Deacon & Laing, 9, St. Paul's Square, Bedford. 4041

RONALD WARD & PARTNERS require an ARCHITECTURAL ASSISTANT, with contemporary outlook and willing to use own initiative. Salary range £500 to £800. Interesting and varied work, home and abroad. Congenial working conditions.—Apply 29, Chesham Place, Belgrave Square, S.W.1. Tel. Belgravia 3361. 4032

JUNIOR ARCHITECTURAL ASSISTANT required, Intermediate standard, for practice in Ilford, Essex. Good prospects.—Apply G. F. Siegerts, 1, Electric Parade, Seven Kings Road, Seven Kings, Ilford, Essex. 4031

ASSISTANT wanted for small private practice. Write brief details to T. A. Bird, 13, Welbeck Street, W.1. 4029

TROFDEK.—SENIOR and JUNIOR ASSISTANTS required immediately for design department and drawing office in Lincoln. Applicants with general structural background and building construction experience will be given responsible position, high salary, very congenial working conditions, and excellent prospects for rapid advancement.—Please write fully, Box 4028.

SENIOR ASSISTANT required, capable of taking full responsibility of contracts, dealing with Client and Contractor. Must belong to the Modern School of Design.—Write, stating experience, age, and salary required, to John H. D. Madin, Dip.Arch.Birm., A.R.I.B.A., 83/85, Hagley Road, Edgbaston, Birmingham, 16. 4027

J. DOUGLASS MATHEWS & PARTNERS, Chartered Architects, 3, Ebury Street, London, S.W.1, require further medium grade ASSISTANTS. Salaries in accordance with experience. It would be helpful if previously unsuccessful applicants do not apply. 4026

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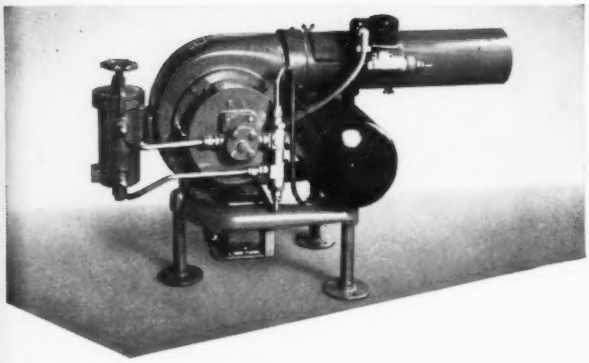

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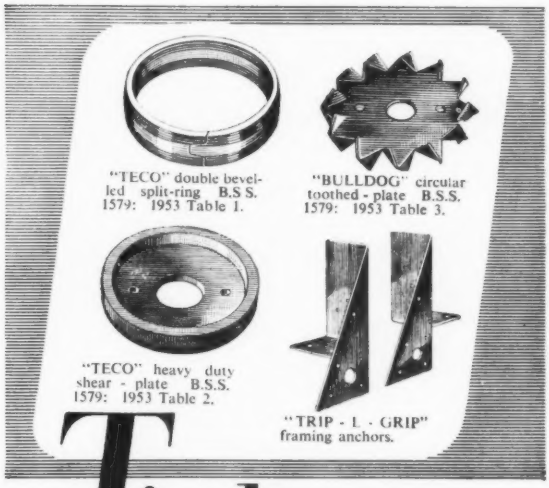

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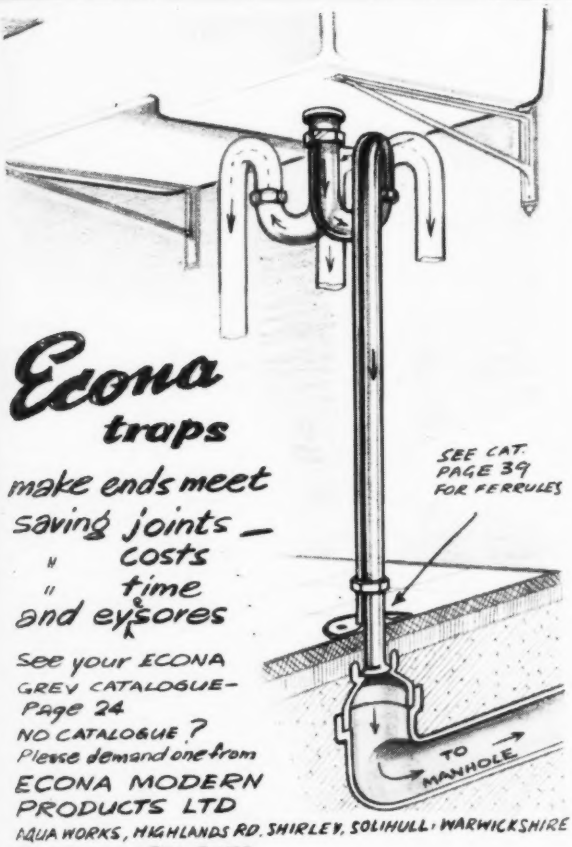

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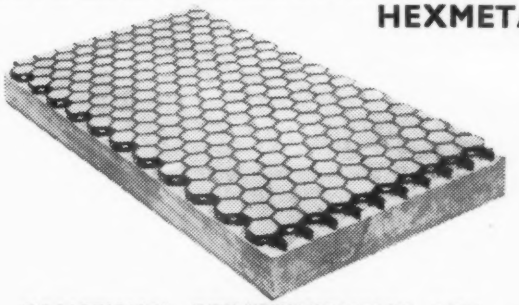

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